HEC-HMS Guidance

for the Contra Costa County Flood Control
& Water Conservation District
Unit Hydrograph Method

by Mark Boucher

August 16, 2011

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Table of Contents

Contents

List of Tables

List of Figures

Disclaimer

The instructions and tips provided in this document should not be understood to be official instructions or training towards or for becoming proficient with or an expert in the District's methods or the use of HEC-HMS. The District has not written this document to ensure that the reader and user of this document's instructions in District's methods or HEC-HMS become competent in their use.

The Template Model (Template) referred to in this document has been created by the District. It was created for your convenience. The District has taken care to make it useful and accurate. However, it is possible the District has entered data into the Template incorrectly or has set, or chosen, settings or options incorrectly. Therefore, the District does not warrant or guarantee the information or data in this document or the Template to be correct, accurate, and complete, or without defect and error.

The reader and user of this document should use his or her own judgment to review and correct the instructions and the Template including model inputs, settings, and results if and where needed. It is the responsibility of the engineer using the Template to confirm that the data in the model is accurate and without error as received and as modified.

The user of the Template is also directed to the disclaimer in the "Description" field of the Template and the "Terms of Conditions of use for HEC-HMS" in the U.S. Army Corps of Engineers manuals.

Document Update Summary

This document was updated on the date shown on the cover and footer. By quick review, spelling, typing, and grammar errors were corrected. Some of the tips were updated. The document was not thoroughly reviewed.

The current preferred version of HEC-HMS is version 3.5. It is stable in the Windows 7 operating system. The screen shots and direction provided herein are based on HEC-HMS v3.3. The basic functionality of HEC-HMS is the same, however, some the graphical user interface (GUI) for v3.5 is different from v3.3 and the screen shots provided herein should still provide enough continuity with v3.5 that they are applicable. We will likely update this document in the future to address important changes in HMS version.

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HEC-HMS Guidance

for the Contra Costa County Flood Control
& Water Conservation District
Unit Hydrograph Method

Introduction

For many years the Contra Cost Flood Control and Water Conservation District (District) has used several internally developed programs to perform hydrology calculations. These programs were written in FORTRAN. The District's HYDRO6 program runs in a DOS mode for input and produces unit hydrographs and flood hydrographs on screen and in an output file. The District's HYDRO2 program runs using an input file with unit hydrographs produced by HYDRO6 and/or also hydrographs entered in the input file. HYDRO2 can be used for complex watershed models including multiple watersheds and on-line or off-line detention basins. However, it is limited to only the District's method and does not have a Windows graphical users interface.

Anyone wanting a hydrograph for use in a flood study must request the hydrograph from District staff. They may use other programs (HEC-1, HEC-HMS, Mouse, MIKE11, or other hydrology software) to perform more complex watershed hydrology analyses.

Recent comparisons of the HEC-HMS (HMS) model and HYDRO6 have revealed some subtle differences between the two models and some minor problems with HYDRO6. APPENDIX A presents those differences.

In an effort to find a replacement for its proprietary programs, District staff has verified most of the standard data needed for HMS modeling. These include rainfall distribution curves, the S-curve used for the unit hydrograph method, and the lag equation. Others standards staff is verifying are watershed N-values, infiltration rates, and methods used in measuring or calculating specific parameters for the hydrology calculations. The District's Hydrology Section is continuing to review these standards and provide guidance to the public.

Overview

Guidance Document

This document describes how to use HMS to model a watershed and produce the same results one would get from using HYDRO6. The purpose is to be concise and yet complete. This document is not intended to explain all aspects of HMS or the District's method. This document also includes guidance on using a Template model put together by the District, tips, and other information that may be helpful to the readers who are not familiar with HMS.

Template HMS Model

The Template model is available for download from the District's website[1] and has the District's standard rainfall distribution curves, and S-curve in it as well as a single watershed set up to run. In essence, the data for the standards curves mentioned in this guidance document are included in the Template model and do not have to be manually input if you start a project with the Template model.

The District created this Template model for several purposes:

1. To simplify the building of an HMS model for the District's methods.
2. To provide a clear starting point for modelers with accurate standard curves.
3. Reduce the time to review the HMS models by assuring the standard curves were input correctly.

We recommend that you download and open the Template model and follow it as you go through this guidance document. The Template model will not match the figures in this document perfectly, but using them together should increase your understanding of how a HMS model is put together for using the District's method.

[1] Go to http://www.cccounty.us/index.aspx?NID=530 and click on "Hydrograph Standards" in the left sidebar.

Building a HEC-HMS Model

A model in HMS[2] is made by starting HMS and creating a new project. The following is a list of steps for setting up an HMS model.

On the "Components" tab

- A **Basin Model** is created with subbasins and other elements needed for the model. The subbasin characteristics are entered into to the Basin Model.
- **Control Specifications** are created to define the date and time for which the model is to be run.
- **Time Series** data is entered including rainfall patterns and known hydrographs if any.
- **Paired Data** is input to define the S-curve, and if needed, stage-storage and stage-discharge relationships as well as a storage-discharge relationship.
- A **Meteorologic Model** is set up. This assigns the rainfall time series data and storm rainfall depths to the watersheds in the Basin Model for various storms.

On the "Compute" tab

- The model **runs** are set up as combinations of Basin Models, Meteorologic Models, and Control Specifications. These are called "simulations" in HEC-HMS.
- This allows many combinations of different model parts to run various scenario simulations.

On the "Results" tab

- The results of each simulation are organized Results tab just like the model runs are organized on the Compute tab.
- From here you can view the results in graphical and tabular form.

Input and Results in DSSVue

The results of the HMS models, as well as the input curves and time series data, are saved in Data Storage System (DSS) files. This makes them easily transportable to other HEC models. The DSS files can be viewed using DSSVue[3] and from there copied and pasted or exported to other formats such as Excel.

The sections that follow provide more details for building a basic HMS model with screen and menu shots provided for clarification.

Template Model Content

The Template model contains all of the basic time series data and paired data related to the District's standards and was set up to follow naming conventions suggested in this guidance. Though this guidance describes steps to set up a model, you can skip many of these steps by using the Template.

[2] The HEC-HMS (Hydrologic Engineering Center - Hydrologic Modeling System) program is available for download without charge at http://www.hec.usace.army.mil/software/hec-hms/. This document is based on version 3.3.

[3] Hydrologic Engineering Center Data Storage System Viewer (HEC-DSSVue) program is available for download without charge at http://www.hec.usace.army.mil/software/hec-dss/hecdssvue-dssvue.htm.

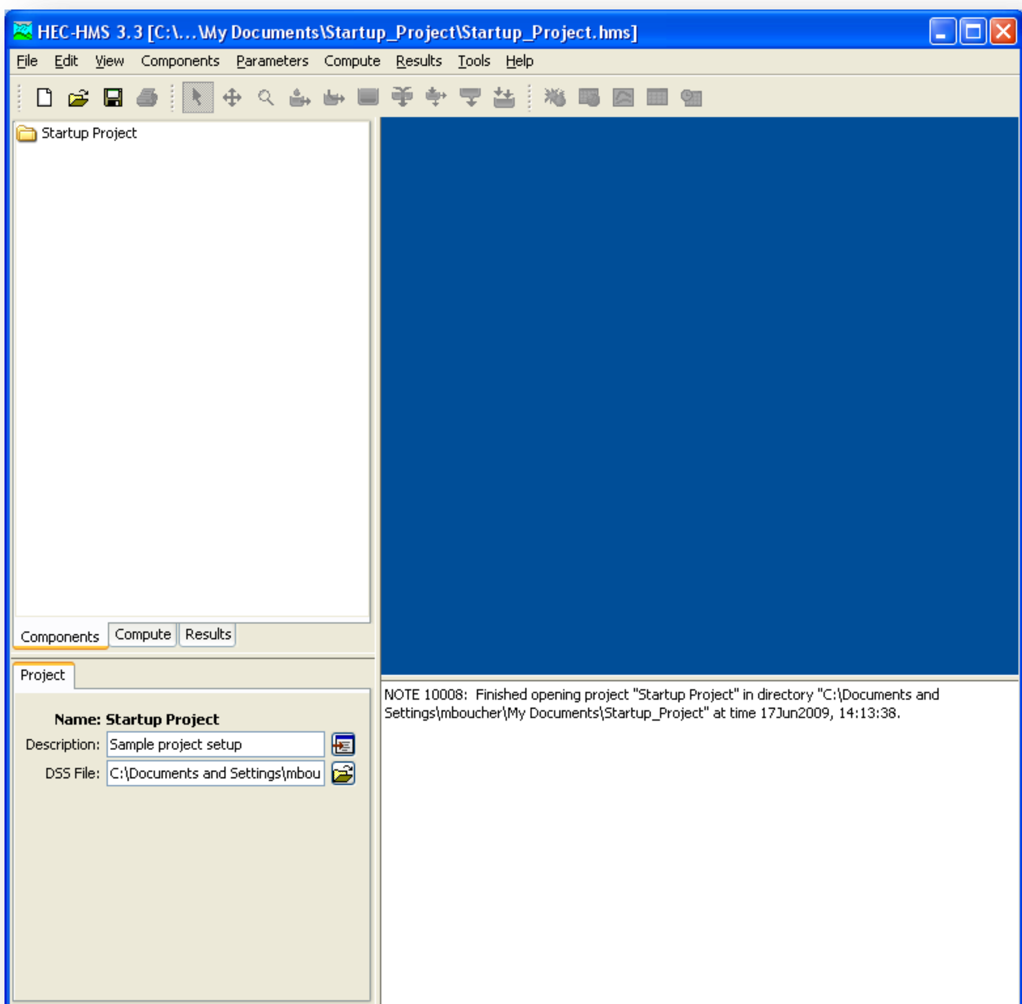
Project Creation

After starting HMS, choose File/New. In the dialogue box, enter a descriptive name for the HMS project, select the location for the model's files, and choose U.S. Customary units. Click "Create".

After creating the project, the HMS window (**Figure 1**) will show a folder with the project name, the description, and the location of the DSS file for the project. The HMS program stores time series and pared data as well as the model results in the DSS file.

If you download and use the Template model from the District website, many of these steps can be skipped.

Figure 1 HMS Project Creation Example

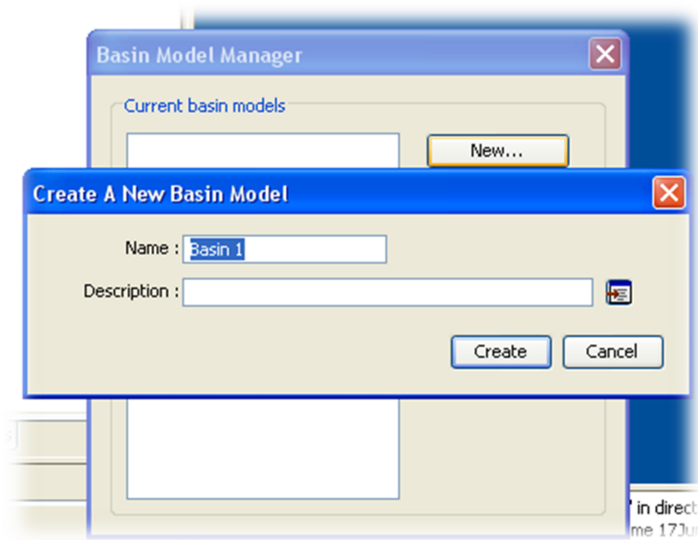


Component Creation

Using the Components menu (see image to right) and the "managers" under it, you must create at least one of each of the following for a model using the District's method:

- Basin Model,
- Meteorologic Model,
- Control Specifications, and
- Time-Series,
- Paired Data.

Model Manager

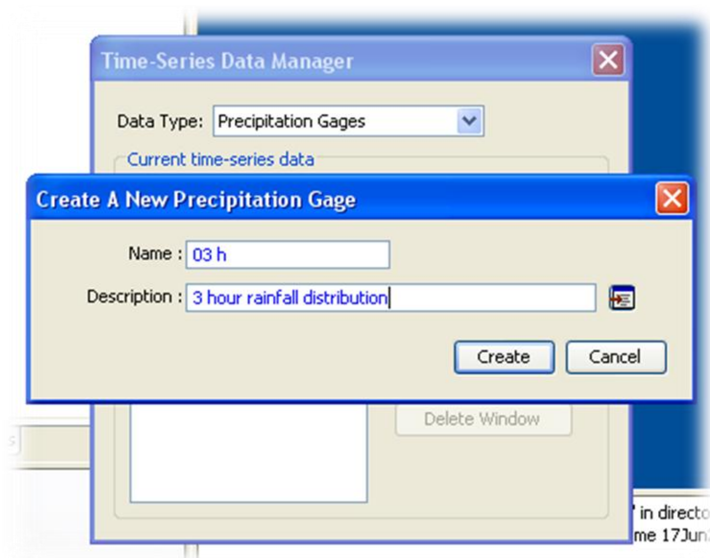


Using the **Basin Model Manager**, create a basin. Name it what you want and enter a description as needed. The Basin Model will contain subbasins (watersheds) and other elements such as detention basins.

Do the same with the **Meteorologic Model Manager**, and **Control Specifications Manager**. These managers do not have options other than creating and naming components. The components are edited later to add model specific information.

Time Series Manager

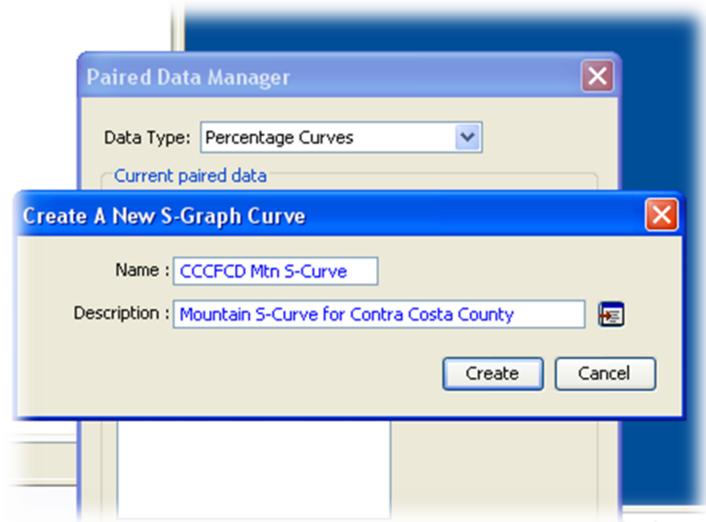
The **Time Series Manager** requires more information. In the image to the right, a precipitation gage is defined for the 3-hour rainfall distribution curve. The actual data for the curve will be input later. Notice the name is "03 h" and not "3 h". HMS sorts the components alphanumerically by their names. By including a "0" in front of the "3", the "03 h" curve will be listed before "06 h" and "12 h" in the list of precipitation gauges. In addition, using the "h" instead of the word "hour" saves typing time and space in table and plot labels later on.



This convention is a District preference. We have learned that this practice of naming the components aids in organization, management, and review of the models.

Paired Data Manager

The **Paired Data Manager** also requires more information. In the image to the right, we have selected “Percent Curve” for the S-curve we will input later. The paired data manager is where placeholders are created for stage-storage curves, stage-discharge curves, etc. Any paired data that is not associated with time is entered using this manager.

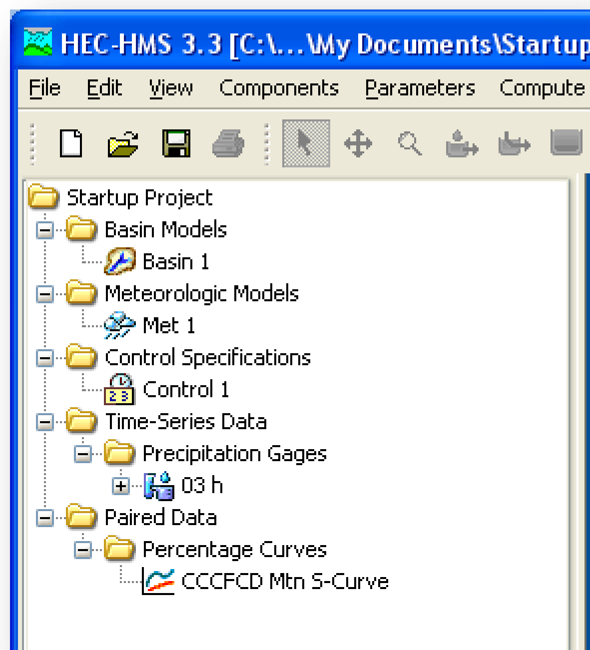


Folder View after Creating Components

In the image to the right, we have expanded the “folders” for entire HMS model and exposed all of the components created using the Component Managers.

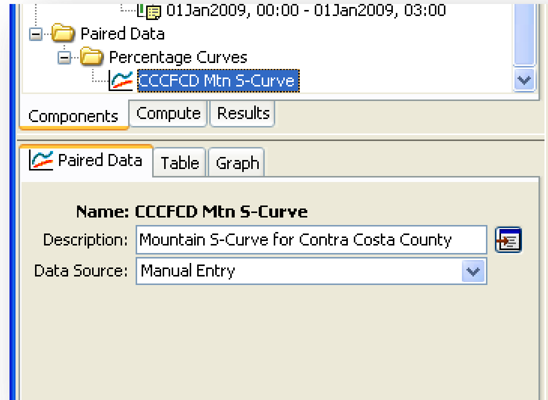
These are the components needed to run a model using the District’s method. Beyond this, you can create more Basin Models (with multiple subbasins, detention basins, junctions, diversions, sinks), Meteorologic Models, Control Specifications, Precipitation Gages and other paired data.

A good practice would be to set up a basic model like this, including the standard rainfall distribution curves and S-curve and save it as a template for future modeling work. This will save time and assure consistency. Later in this document, we present such a Template we have created for use in Contra Costa County.



Data Entry

The data entry order is not critical except that some elements depend on data from others. For example, for the District method, each subbasin needs the S-curve data for its transformation method and the Meteorologic Models need the precipitation gage data. Below, we describe an order of data entry that inputs data in a logical order to reduce having to go back and forth between model elements and data entry.

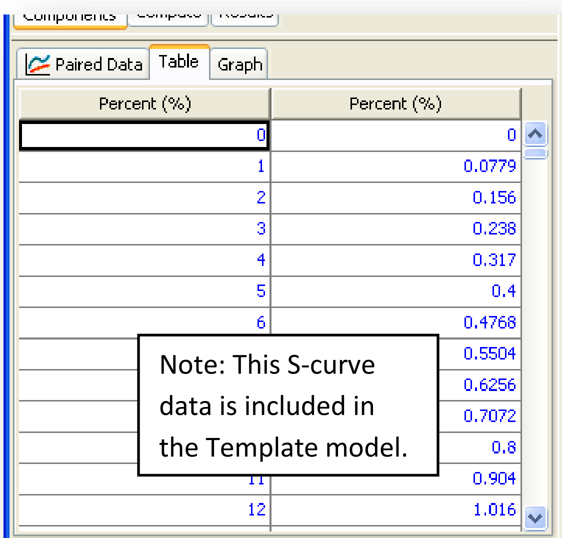


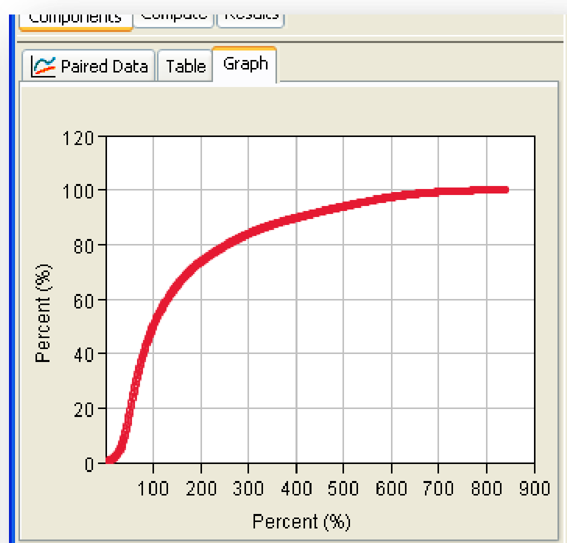
Paired Data

Because the Basin Model requires the selection of the S-Curve, you should enter it first. Otherwise, you have to go back to the Basin Model again after entering the paired data. Paired data consists of both X and Y values. The District's S-curve has 840 X-Y values and is not provided in this document. It is included in the Template model and is also available in electronic format from the District website at: http://www.cccounty.us/index.aspx?NID=2455.

By clicking on the S-curve component created earlier, three tabs are shown. The "Manual Entry" option shown for "Data Source" on the **Paired Data** tab in the image above is correct.

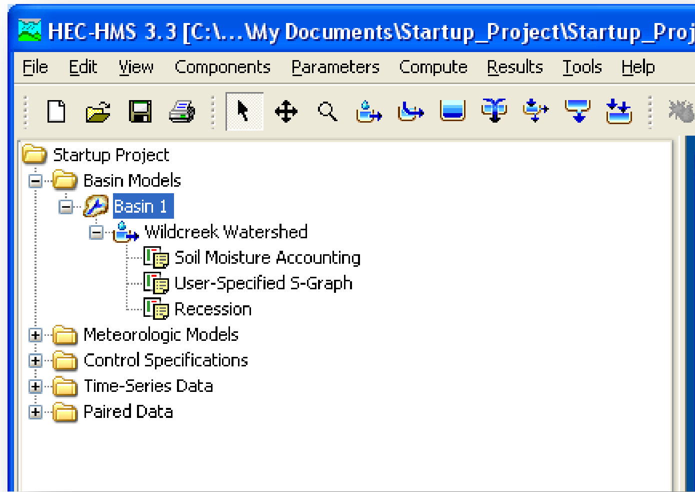
The paired data entry forms have **Table** and **Graph** tabs for data entry and graphical review. For the basic model (a model without detention basins, diversion, etc.) the S-curve is the only paired data required for the District's modeling method. Other paired data include stage-storage and stage-discharge curve for detention basins.





Basin Model

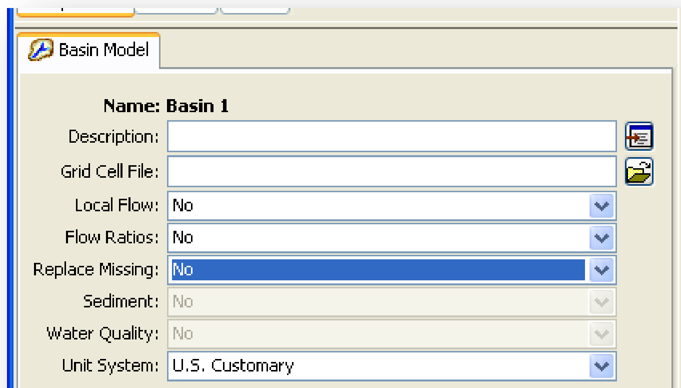
You can model many subbasins (watersheds) in a Basin Model. You can join hydrographs, create detention basins, define junctions and diversions, and use routing methods to estimate the attenuation of flow down the creek. You can perform many other hydrologic tasks. However, at its basic level, the basin model needs at least one subbasin. The example that follows includes only one subbasin.



Basin Units

The units used in the modeling should be consistent with your project. We use the U.S. Customary units in Contra Costa County. The units on the subbasin should be checked to make sure they match what you are using in your project.

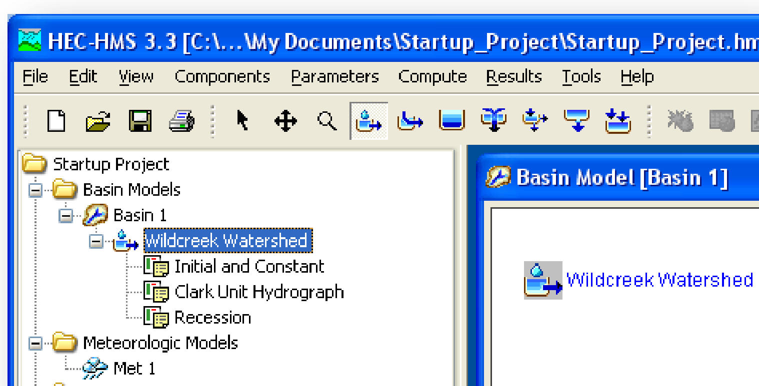
When you select the basin icon, the lower portion of the window shows basin information. The bottom item is the "Unit System". Select the correct units for your basin using this window.



Subbasin Creation

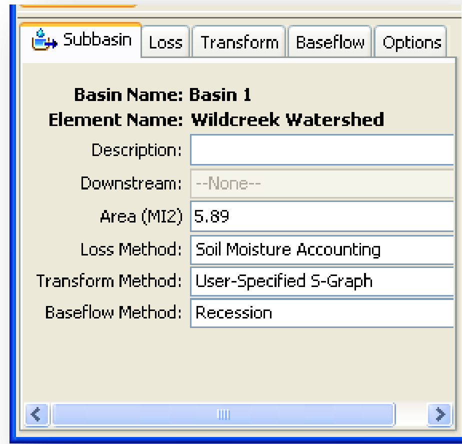

= Subbasin Creation Tool

In the image to the right, we have created a subbasin by clicking on the Subbasin Creation Tool (icon defined above right), clicking in the "Basin Model [Basin 1]" window, entering the name "Wildcreek Watershed" and clicking "Create". In the image, we have expanded the "Basin 1" basin folder and the Wildcreek Watershed subbasin folder to reveal other parts of the subbasin element.



Subbasin Parameters

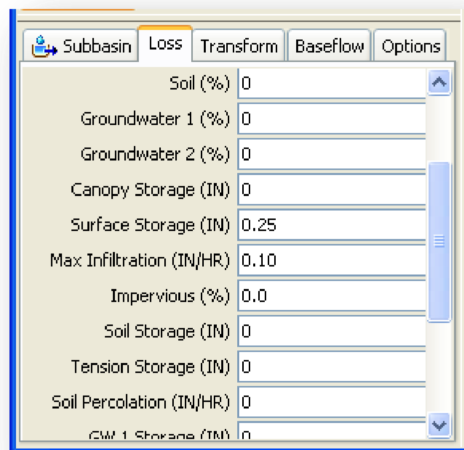
When you click on the subbasin in the folder view, or on the map, the lower part of the HMS window shows tabs related to the subbasin (see image at right).



The first tab is the **Subbasin** tab. A **Description** can be entered. You enter the **Area** under this tab. For the District's method:

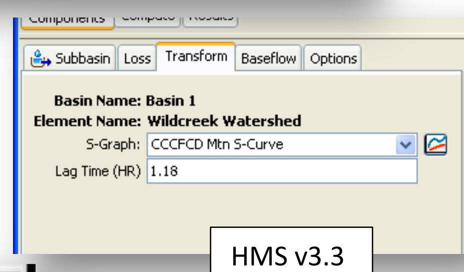
- Loss Method = Soil Moisture Accounting,
- Transform Method = User-Specified S-Graph
- Baseflow Method = Recession.

When you change these options in the **Subbasin** tab, the options on the **Loss**, **Transform**, and **Baseflow** tabs also change. Setting these options as defaults under the **Tools>Project Options** menu saves time in larger projects that have multiple basins.

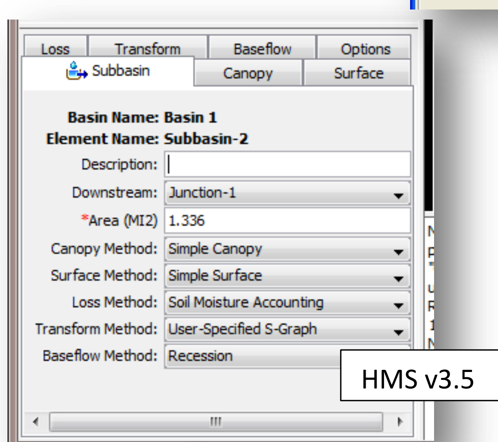


Clicking on the **Loss** tab reveals that the Soil Moisture Accounting method has numerous fields for input. For the District's method:

- All the fields must be set to "0", except for two; otherwise, the model will not run.
- Surface Storage = 0.25 inches
- Max Infiltration = the constant infiltration, which varies with land use is input here.

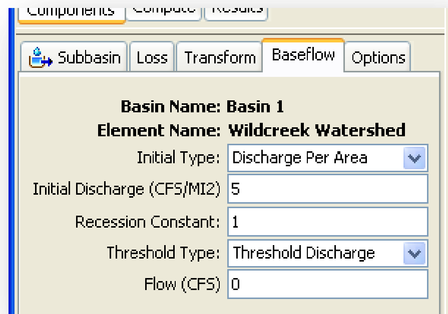


The GUI for subbasins has changed between v3.3 and 3.5. Version 3.5 provides separate tabs for the Canopy and Surface where they used to be included in the "Loss" tab (see images to the right). The Canopy option can be set to "—None –" and the Surface options should be "Simple Surface" with 0% initial storage and 0.25 in Max Storage which is equivalent to "Surface Storage" in the previous version.



The **Transform** tab is where you choose the **S-Graph** (aka S-curve) for the Subbasin. The **Lag Time** is unique to each subbasin. Calculation of the District's Lag Time is described in **APPENDIX A** .

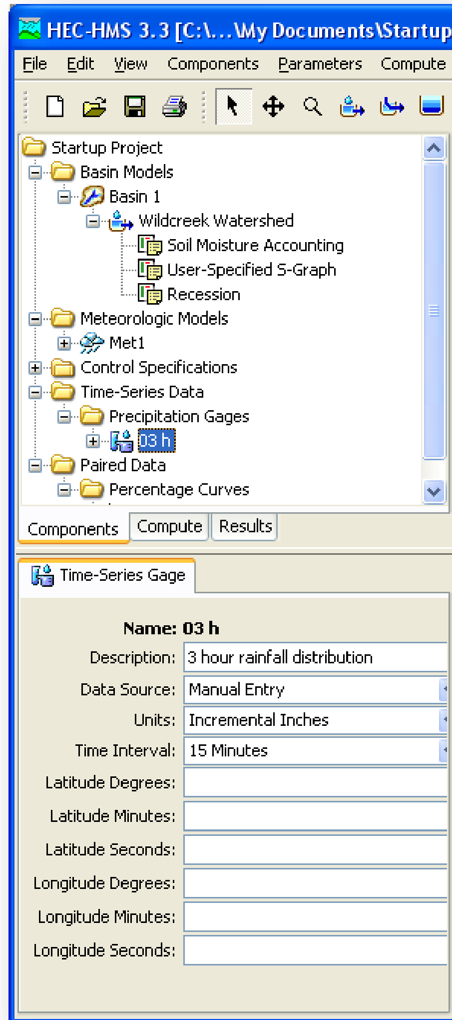
The District's **Baseflow** standard is a constant 5.0 cubic feet per second per square mile (cfs/sq. mi.). The settings are:



- Initial Type = Discharge Per Area
- Initial Discharge = 5 cfs/sq. mi.
- Recession Constant = 1
- Threshold Type = Threshold Discharge
- Flow = 0 CFS
- The **Options** tab is explained in **APPENDIX A** .

Time Series Data

For the District's method, time series data consists primarily of precipitation data input for the rainfall distribution curves. The **Meteorologic Model** will provide the option of **Total Override** that must be set to "yes". This option causes the total storm rainfall depth entered into the Meteorologic Model to be distributed over time in the same pattern as input in the time series for the precipitation gage.

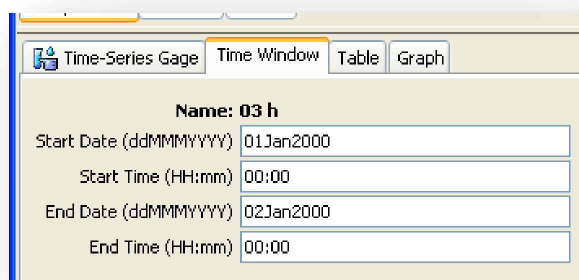


The image to the right shows the 03 h Precipitation Gage we create earlier and the **Time-Series Gage** tab visible in the lower window. The District's method requires:

- Data source = "Manual Entry"
- Units = "Incremental Inches"
- Time interval = (dependent on rainfall distribution curve. See APPENDIX B).

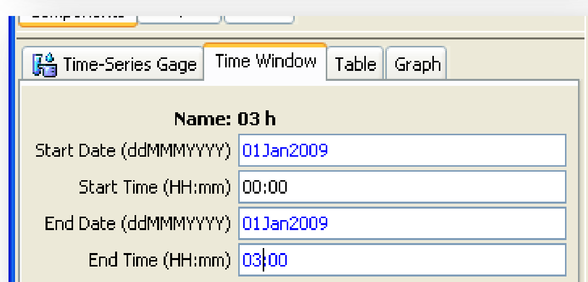
The District's standard data comes in 15 minute, 30 minute or 2 hour time intervals. The 15-minute time interval is correct for the District's standard 3-hour storm rainfall distribution we will input to this gage in our example.

After clicking the plus sign next to the time series and selecting the "time window" below the "03 h" icon, you will see other tabs appear. In the **Time Window** tab, change the start and end date and time for the rainfall data. Use the ddMMMYYYY format as shown.



IMPORTANT: The time series time and date must be within the Control Specifications Component time and date you will create later.

The HMS default is likely different from what was input for Control Specifications or any other time series you may have entered. Change the start date and time to be the same as the modeling period you want to use. Enter an end time so that it is at or beyond the time of the end of your gage data.

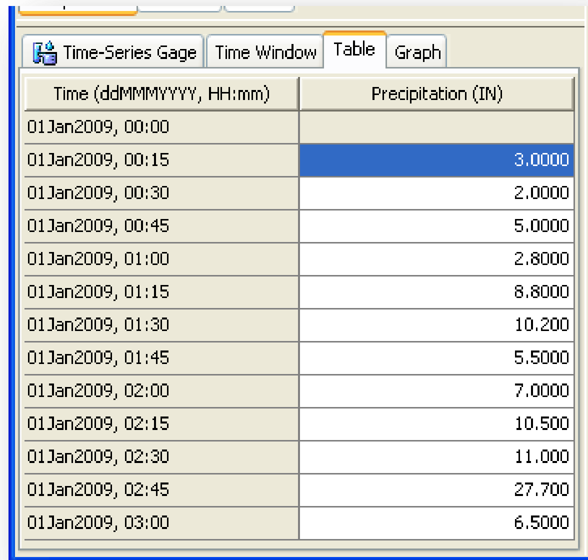


For the 3-hour curve, you can set the time and date as shown in the image on the previous page. (NOTE: When you input data, the text changes to the color blue and then black when you save).

The precipitation time series data for the 3-, 6-, 12-, 24, and 96-hour storms are included in the Template model.

The District's 3-hour rainfall distribution curve is shown at the right. This is put into the **Table** tab of the "03h" Time-Series Gage. This and other district rainfall distribution curves are provided in **APPENDIX B** .

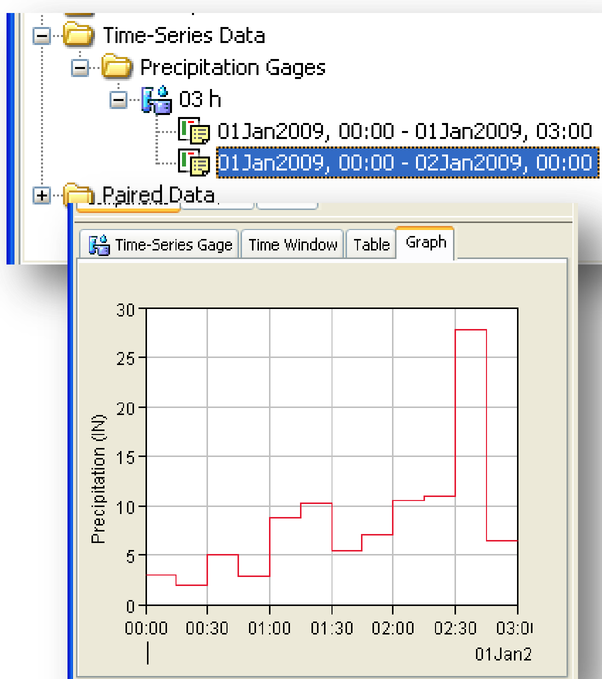
3-hour Rainfall Distribution Curve (15 minute Intervals)
3.0
2.0
5.0
2.8
8.8
10.2
5.5
7.0
10.5
11.0
27.7
6.5



Time (ddMMMYYYY, HH:mm)	Precipitation (IN)
01Jan2009, 00:00	
01Jan2009, 00:15	3.0000
01Jan2009, 00:30	2.0000
01Jan2009, 00:45	5.0000
01Jan2009, 01:00	2.8000
01Jan2009, 01:15	8.8000
01Jan2009, 01:30	10.200
01Jan2009, 01:45	5.5000
01Jan2009, 02:00	7.0000
01Jan2009, 02:15	10.500
01Jan2009, 02:30	11.000
01Jan2009, 02:45	27.700
01Jan2009, 03:00	6.5000

The date and time on this tab reflect the **Time Window** tab settings. The District's standard rainfall distribution curves are available in its standards document and in electronic format[4] and can be copied and pasted into the HMS time series tables.

Note that the rainfall input starts at the start of second time interval.

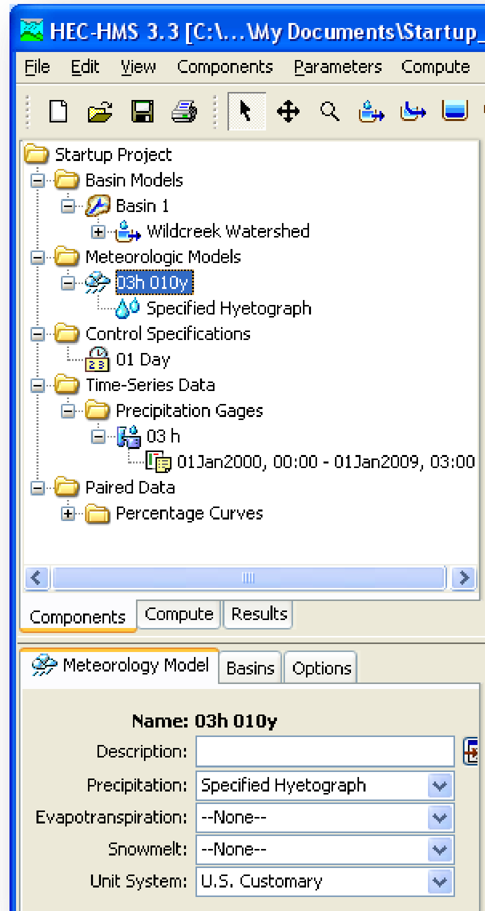


If a gage is combined and is run with different Control Specifications, HMS will create a different time window under the Time Series Gage. Though this may clutter the folder view, it does not alter the Precipitation Gage data. Time windows can be deleted using the right click menu options. Be sure that the remaining time windows contain all of the precipitation gage data and make sense as part of your model.

The precipitation data can be visually checked via the **Graph** tab.

[4] The rainfall distribution curves are entered into the Template model that is available on the District's website at http://www.cccounty.us/index.aspx?NID=2664. They are also available via http://www.cccounty.us/index.aspx?NID=2455.

Meteorologic Model



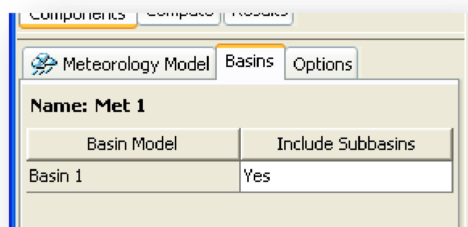
The **Meteorologic Model** assigns the storm rainfall to the subbasins. For the District's method, we use it to apply the rainfall pattern and total design storm rainfall amount to the subbasins. Click the Meteorologic Model and look at the tabs in the lower left portion of the HMS window.

The Meteorologic Model should look like the image to the right (except for the model name):

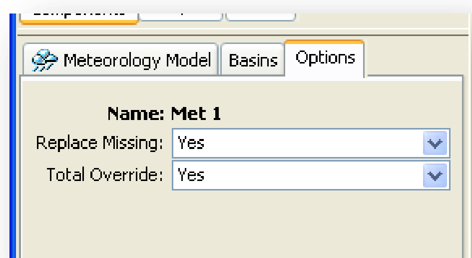
- Precipitation = Specified Hyetograph
  Evapotranspiration and Snow Melt = None
- Units System = U.S. Customary.

If you are working with only one basin model, you do not need to duplicate the basin model for each design storm. You simply need to create a Meteorologic Model for each design storm. Then use each of them with the same basin model.

You may have "pre" and "post" conditions models. You would need different basin models for these because the subbasins would have different characteristics.



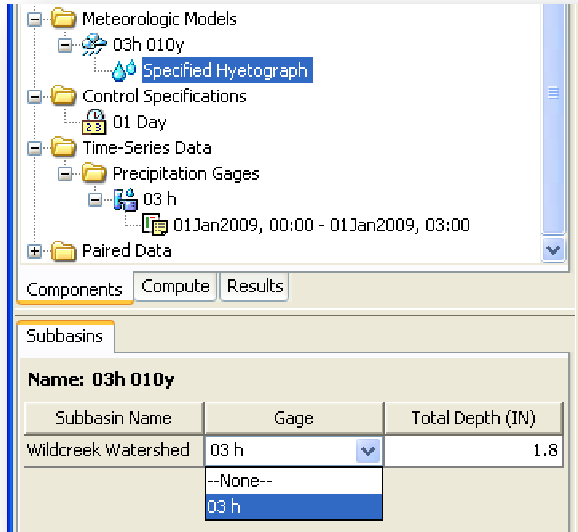
On the **Basins** tab, the basins that the Meteorologic Model will apply to should have "Yes" selected by their names. This indicates that this Meteorologic Model can be used with these basins. The reason for this option is that there are times when you would want to prevent the "accidental" use of a Meteorologic Model with a specific Basin Model.



On the **Options** tab, the **Total Override** should be set to "Yes". This tells the Meteorologic Model to replace the precipitation gage total with the storm total (to be entered later). In effect, this makes the precipitation gage a rainfall distribution pattern because it overrides the rainfall depth in the precipitation gage with storm total for the subbasin. If you choose "no" for this option, you would have to scale the precipitation gage data to equal the rainfall depths or each time step. The rainfall distribution simplifies the modeling effort.

Rainfall Distribution Gage and Depth

If the precipitation gage is input, for each subbasin you can set the precipitation gage (rainfall distribution pattern) and enter the storm rainfall depths (aka total storm rainfall amount).



To do this, click **Specified Hyetograph** Under Meteorologic Model folder and choose the gage you want for each Subbasin. In the example to the right, we choose the 03 h gage and put in the **Total Depth**.

The Total Depth is related to the return period of the storm so this is a good time to rename the Meteorologic Model. In this case, this is a 3-hour, 10-year storm and we renamed the Meteorologic Model to be the "03h 010y" (see Tips on renaming in APPENDIX A).

Keep in mind HMS will order the elements alphanumerically. The name you give the elements will affect the sort order HMS puts it in. We used the "010y" for the return period because we might have a 100-year run that we might name "03h 100y" and a 50-year run that we might name "03h 050y". HMS will sort these in order as follows:

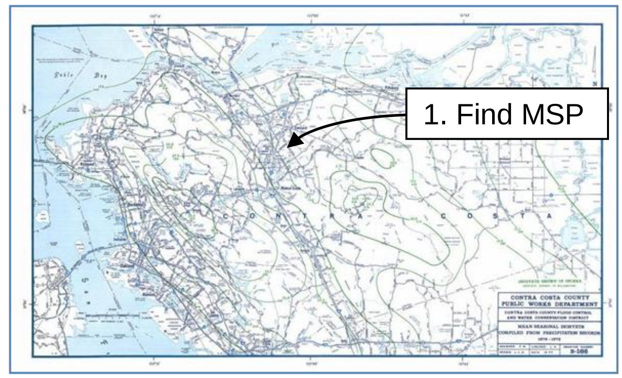
03h 010y
03h 050y
03h 100y

The District prefers this naming convention and submittals to the District for review should follow it.

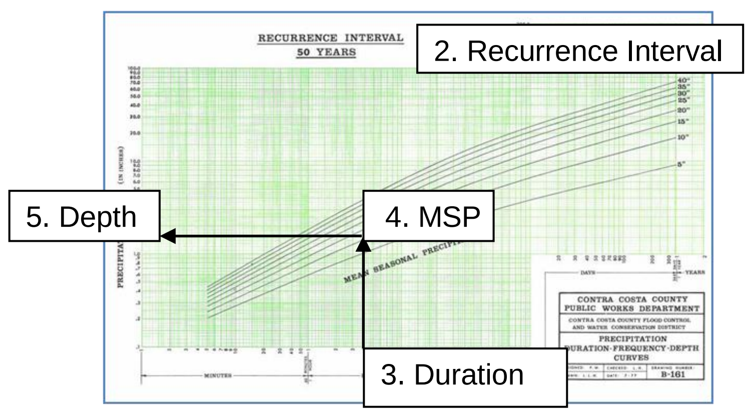
Storm Depths from Map and Curves

The District's Isohyet Map[5] (image right) and Duration Frequency Depth (DFD) Curves (image below right) can be used to get the total depth for entry into the HMS Meteorologic Models. The Mean Seasonal Precipitation (MSP; aka Mean Annual Precipitation) can be measured at the centroid of small watersheds, but should be averaged over the area of larger watersheds.

To determine the total storm depth you follow the following steps:



1. Find the MSP for the watershed from the Isohyet Map,
2. Choose the DFD sheet for the recurrence interval (aka return period6) you are interested in,
3. Enter the DFD graph x-axis (time) at the duration of the design storm,
4. Trace the duration up until you intersect the MSP curve for the watershed. Interpolate if necessary.
5. Trace left to the y-axis and note the depth, which is the storm depth for that duration and recurrence interval.[6]



Storm Depths from Equations

The rainfall depth calculated in the HYDRO6 program is based on an equation and tables built into the FORTRAN code. The equation and tables have been checked to verify that they closely match the District's duration-frequency-depth curves. The equations and partial tables from HYDRO6 are provided in **APPENDIX A** .

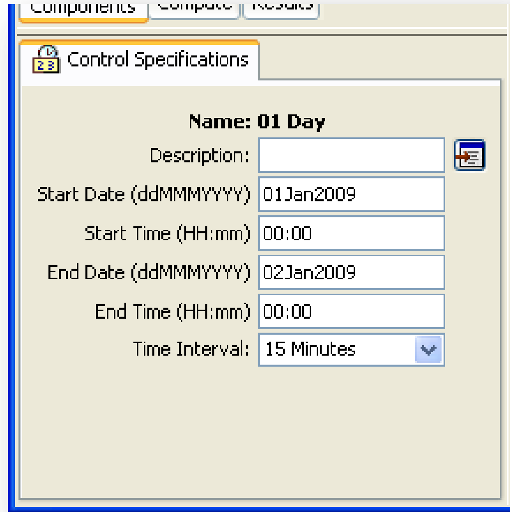
The tables in **APPENDIX A** provide coefficients for standard storm return periods and durations. The 200-, 500-, and 1000-year storms are available, but not included in the appendix. The 9-, 36-, and 48-hour rainfall distribution curves are available, but are not typically used except in special circumstances. Should you need these coefficients, contact the District.

[5] The District's Isohyet Map and DFD curves can be purchased at the Contra Costa County Public Works Department (255 Glacier Drive) or downloaded under the "Hydrology Standards" link http://www.cccounty.us/index.aspx?NID=530

[6] **Recurrence interval**, **return period**, and **storm frequency** are all interchangeable terms.

Control Specifications

Control Specifications define the model start and stop time and the time step interval. You may need more than one Control Specification depending on the start and stop time of your model. For example, you may need the model to run for six hours for a 3-hour storm or you may need it to run for five days for a 96-hour storm.



If the time window is too long, then the output may be excessive and results standard plots may not be conveniently framed over the storm duration.

Warning: If your Control Specifications time frame is less than your rainfall period for your precipitation, the rainfall amount input under the Meteorologic Model will not be distributed over the storm period, but only within the Meteorologic Model time frame. This will result in erroneous rainfall for your model.[7]

The dates and times must be input in the format shown in the image above. For most modeling runs, the actual date and time do not matter. What is important is that the Control Specifications time window be the same as precipitation data time window.

Time Interval

The **Time Interval** is a key element of the model. It determines the length of the time steps in the model. This interval should be reasonably short. We normally do not use a time step longer than the time step of the precipitation data. A 15-minute time step is a standard. Shorter time steps provide more detail on the magnitude and timing of the peak. See **APPENDIX A** item number 2 for a discussion that includes time interval and the peak flow.

[7] We have informed the Corps of Engineers (HEC) about this issue and they may address it in a future version of HEC-HMS.

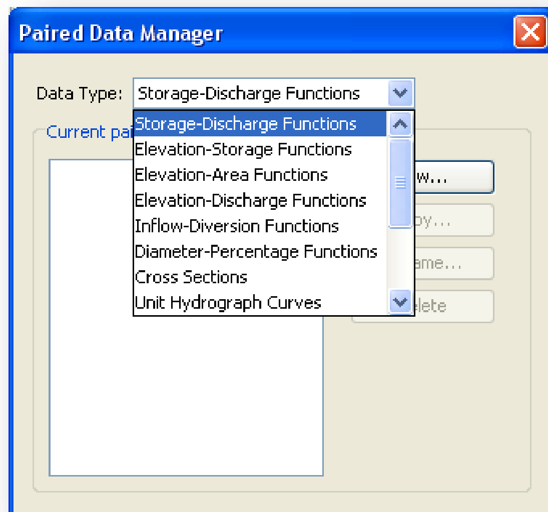
Depth Area Reduction Factor

The Depth Area Reduction Factor (DARF) is also known in other District documents as the Areal Rainfall Reduction Factor (ARRF) or the Area Reduction Factor (ARF). The purpose of the DARF is to reduce the rainfall depth when the watershed being analyzed is large.

The National Weather Service, National Oceanic and Atmospheric Administration (NOAA) has different DARF curves for different storm durations. The District has adopted only one DARF curve for Contra Costa County and applies it to all storms of all durations and frequencies.

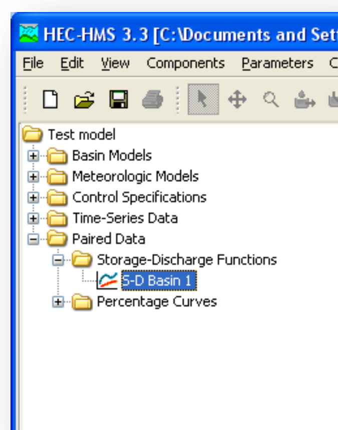
The District's curve and further explanation of the DARF are presented in APPENDIX C . The District's DARF applies only to watersheds over 3 square miles in area.

Using Detention Basins in HMS



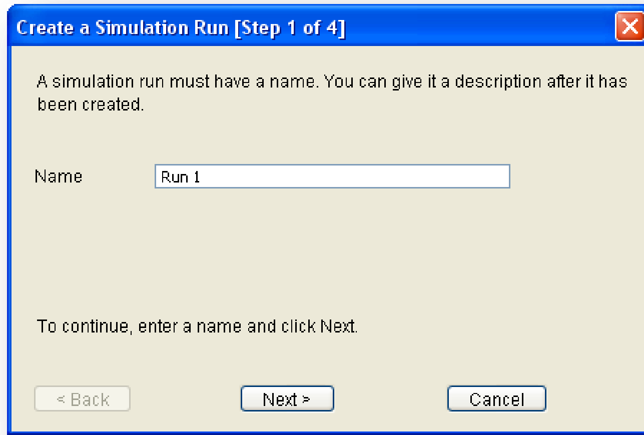
Detention basins, or reservoirs, as HMS calls then, can be modeled in several ways. The most common method used by the District is to model them using the **Elevation-Storage-Discharge** method**.** The curves (paired data) needed for this method are the stage-discharge and stage-storage curves. In HMS these are calls **Elevation-Discharge Functions** (E-D) and **Elevation-Storage Functions** (E-S).

HMS also requires the **Storage-Discharge Function** (S-D). You can create the Storage-Discharge function using the other two functions. If the elevations in the E-D and E-S functions are the same, the S-D curve is easier to create. You create the curves with the Paired Data Manager and then enter the paired data in the appropriate component.

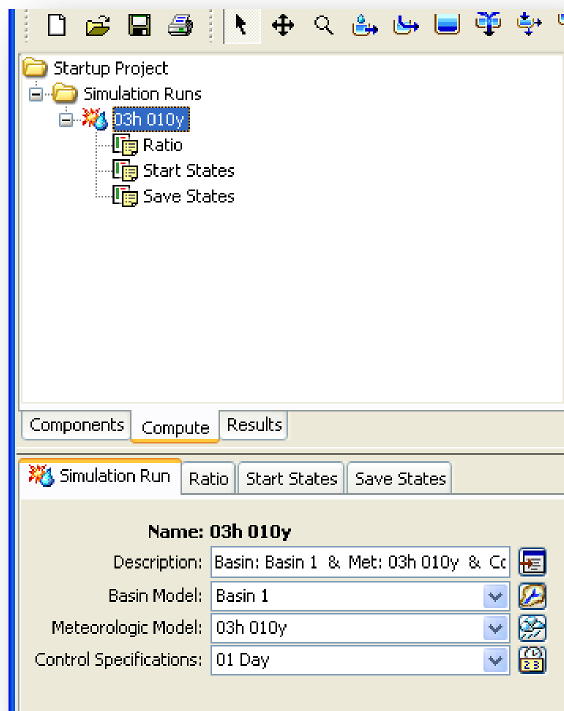


HMS also allows the use of outflow structures such as pipes and spillways. The District will accept HMS models using the outflow structures. The structures in the plans and those in the model must "match" and simplification of the outlet structure will be carefully reviewed.

Running a HEC-HMS Model



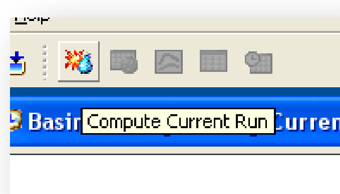
If model components have been created and populated with data, a **Simulation Run** may be created. To create a simulation, click the **Compute> Create Simulation Run** command from the menu. The dialogue box in the right image will appear. Name the simulation appropriately. For example, if we want to perform the 3-hour 10-year run, we could name the simulation “03h 010y”. This name will be used in the output to differentiate between other runs.



After naming the Simulation Run, click “Next”. The dialogue boxes will ask for the Basin Model, the Meteorologic Model, and the Control Specifications. If you only have one each, keep clicking “Next” and then “Finish” to complete the Simulation Run creation. Otherwise, choose the components you want for the modeling run.

Click the **Compute** Tab in the folder portion of the HMS interface and, after expanding the folders, you will find the simulation run. The HMS interface should look like the one in the image to the right.

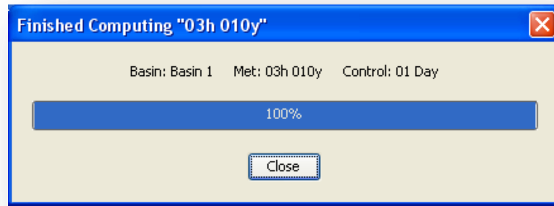
The **Basin**, **Meteorologic**, and **Control Specifications** components show up in the tabs below. For a simple simulation, you would be done setting up the run. For a simulation that requires a DARF you can click the **Ratio** tab and enter the DARF for that purpose. At other times, the rainfall depth can be reduced outside HMS and before it is entered in the Meteorologic Model. You can change the Basin and/or Meteorologic Model and Control Specifications from this window.



To run the simulation you click the “Compute Current Run” icon in the toolbar. You can also right click on the simulation run icon (in this example the icon named “03h 010y” on the Compute tab) and select “Compute”.

The programs should respond by opening a window that shows the progress of the run with a blue bar. Notes will appear in the message window indicating important modeling information including warnings and errors.

When the run is complete (100%), you have to close the run progress window unless you have changed the program settings to close the run automatically. See HMS tips in **APPENDIX A** for how to change the settings.



Understanding the Results

It is important to remember that hydrographs created using models are not "real". The most accurate flows are measured flows taken at stream gages. However, stream gages are expansive to install and maintain at a level that guarantees good data. Also, many years of recording data and verifying the gage rating curves[8] are required to predict a flow frequency (10-year, 100-year, etc.) with confidence.

It would be a daunting task to measure the flow in every creek where we anticipate a flood control or drainage project. It would be unreasonable to wait and measure those flows for many years before taking action. Because of this, rainfall-runoff models such as HYDRO6 and HMS are used.

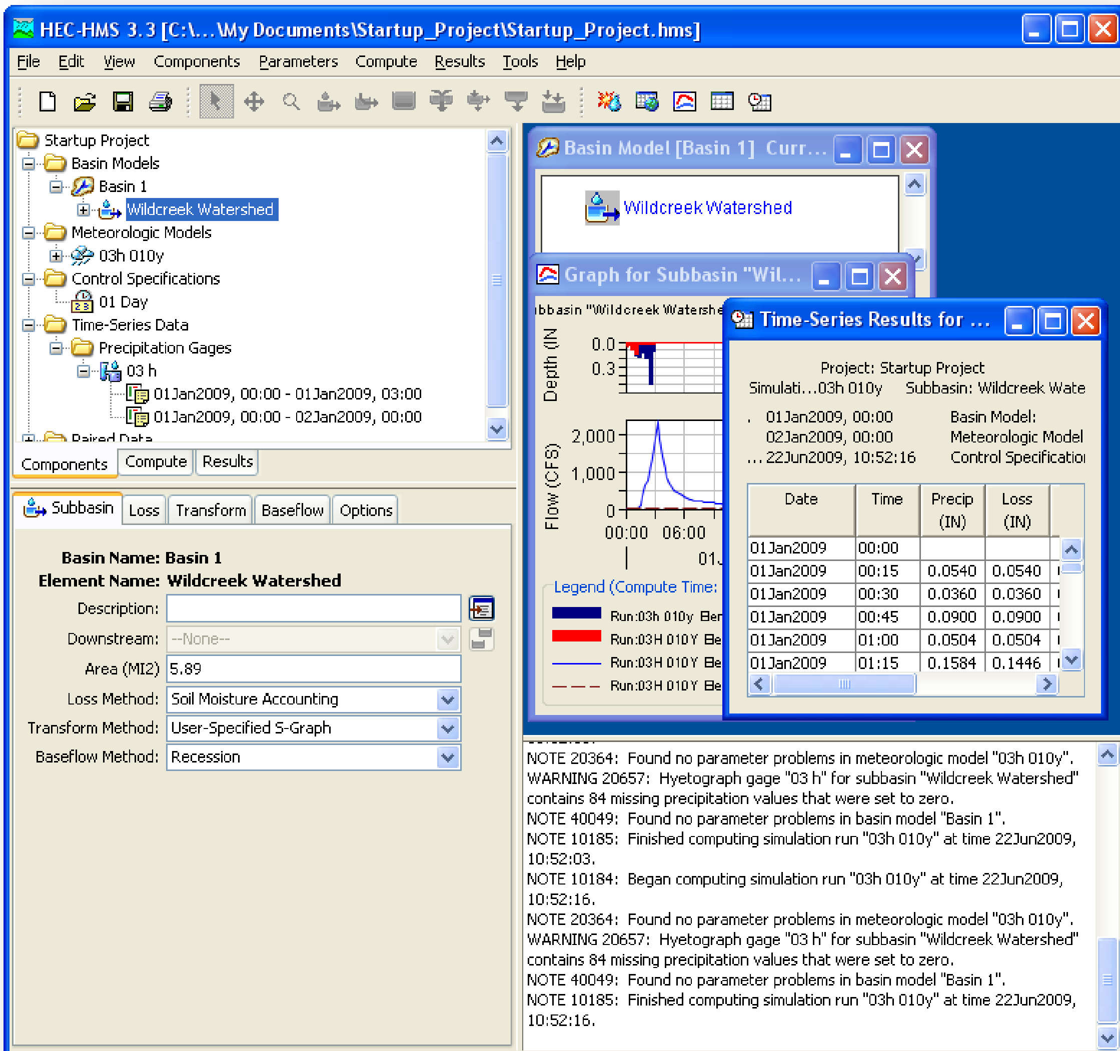
Rainfall-runoff models predict hydrographs and peak flow rates and are normally based on rainfall recorded at rain gages. Rain gages are much more economical to install and maintain than stream gages. To complete the rainfall runoff relationship, we use the few stream gages that do exist to check and calibrate the rainfall runoff model for a few specific storms where both rainfall and stream flow records exist. Once the calibrated relationship is established, we can build standards around the calibration. The result is methods to we can use to calculate design storms.

Therefore, the model results are not "real", they are design storms. They do represent our best estimate of the magnitude of the flows we can expect from a watershed. The District's S-curve Unit hydrograph method was developed by the US Army Corps of Engineers (Corps) during their several studies in Contra Costa County. The District adopted the Corps method as its standard after comparing it to other methods including the SCS curve number method. The S-curve method produced the magnitude and timing of peak flows that more closely matched those of the stream gage data.

[8] A rating curve is a curve that relates the depth of flow measured to a flow rate in the creek or river. Usually, manual measurements are required to establish, verify, and revise the curve in a natural creek.

Viewing Results

Assuming the simulation has run successfully, you can access the results via the **Results** tab, from the basin model map, or from the DSS file.



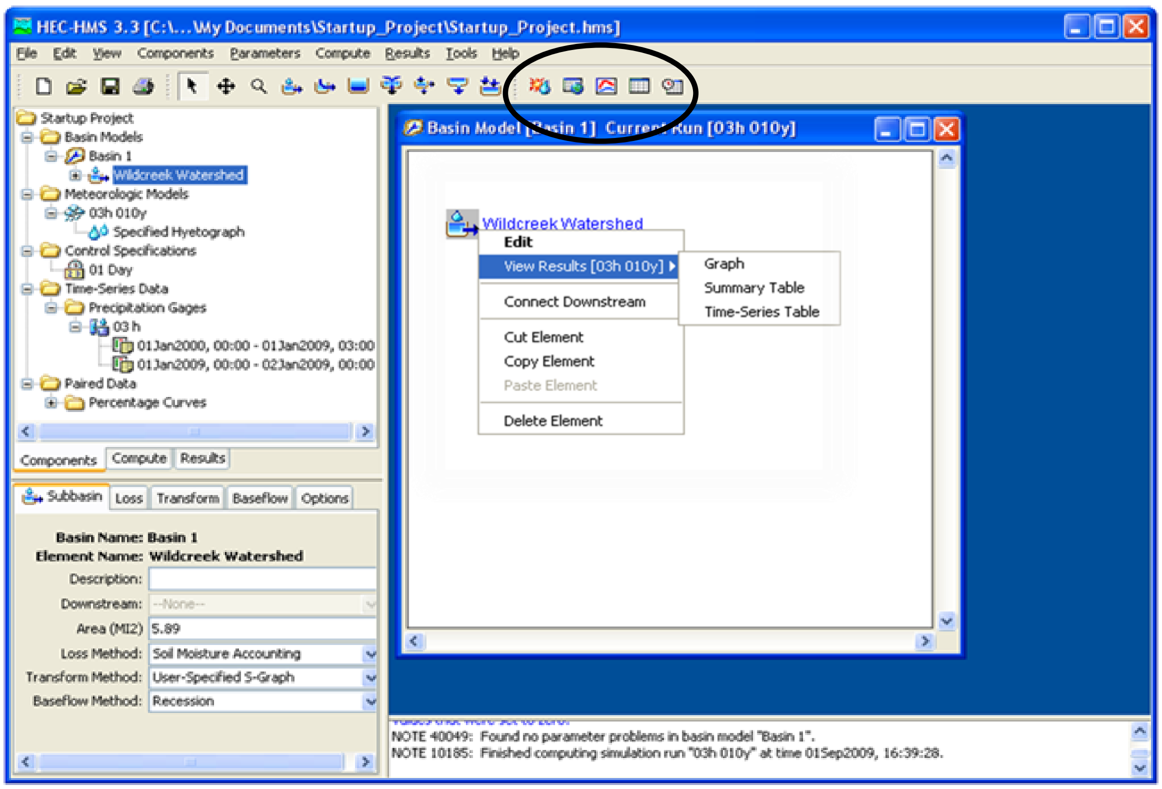
Results from the Results Tab

The results from the **Results** tab are relatively easy to understand. If the model has run, the results icon matching the run will be colored; otherwise, it will be grayed out. Clicking the results icon will expand it revealing various elements of the results. Clicking on those elements will reveal a table or graph. More than one item can be selected for **Preview** tab viewing. Simply use the “Cntl” key while selecting multiple items for viewing. Any graph that appears in the **Preview** tab below the folder tree can be enlarged by clicking the graph icon in the toolbar. A time series table can also be produced by clicking the Time Series icon in the toolbar.

Results from the Basin Model Map

If you click back to the **Components** tab and click on the basin, the basin map should appear. If not, click on a component under the basin model name. By right clicking on an icon on the map a menu will come up with one of the options being "View Results". Please keep in mind that the run you want results for must be the last selected in the **Compute** tab and results will only be available if you have run the simulation after any changes you have made.

You can also click on the icons to the right of the run icon to get various reports, tables, or graphs of the results for the selected basin item icon (see circled icons in graphic below)



DSS File

You may open the DSS file created by the model in the project directory and view as the results there. To do this, you must download and install the HEC-DSSVue[9]. This free viewer is powerful, but it can be somewhat difficult to learn how to use it. This document is not intended as a training tool for the use of DSSVue. We do however, recommend that you use DSSVue and become familiar with its abilities. It comes with a +300-page manual that details all of its uses and capabilities.

[9] Hydrologic Engineering Center Data Storage System Viewer (HEC-DSSVue) program is available for download without charge at http://www.hec.usace.army.mil/software/hec-dss/hecdssvue-dssvue.htm.

One value of the DSS file is that it compatible with other HEC products. For example, a hydrograph in a HMS DSS output file can be read by other HMS models or by an unsteady model in HEC-RAS. This can save time and reduce errors in transferring data between the models.

APPENDIX A Storm Depth Equations

The design rainfall depth is dependent on the desired storm duration and storm frequency. The duration-frequency-depth curves published by the District embody the District's standard for design rainfall depth. You can purchase these at the Contra Costa County Public Works Department office (255 Glacier Drive) or downloaded from County's website. The rainfall depth calculated in the HYDRO6 program is based on tables built into the FORTRAN code. These very closely match the Districts duration-frequency-depth curves.

HYDRO6 Tables

The HYDRO6 program uses the following equation and associated tables in calculating the storm rainfall depth:

$$\boldsymbol{D = \left(\frac{MR1}{100}\right) - (10 - MSP) \times \frac{MR2 - MR1}{2500}}$$

Where:

D = storm rainfall depth (inches)
MSP = mean seasonal precipitation depth (inches) from the District Isohyet map. The value of MSP should be within the range of 10 and 35 inches/year.
MR1 = constant for storm duration and frequency from Table A-1
MR2 = constant for storm duration and frequency Table A-2

Table A-1 MR1 Constants for Storm Rainfall Depths - HYDRO6

MR1	3-hour	6-hour	12-hour	24-hour	96-hour
2-year	55	73	97	124	200
5-Year	81	108	142	186	302
10-Year	95	128	170	222	366
25-Year	110	150	200	262	436
50-Year	128	171	228	300	498
100-Year	138	188	252	332	552

Table A-2 MR2 Constants for Storm Rainfall Depths - HYDRO6

MR2	3-hour	6-hour	12-hour	24-hour	96-hour
2-year	131	184	257	345	621
5-Year	190	270	374	512	900
10-Year	224	318	448	618	1110
25-Year	262	379	530	733	1300
50-Year	300	430	606	840	1480
100-Year	328	468	660	920	1660

Simplified Tables

If we simplify the above equation, we can reduce the number of operations in the equation from six to two and perform the calculations faster.

$$\boldsymbol{D = C1 + MSP \times C2}$$

Where:

D = storm rainfall depth (inches)
MSP = mean seasonal precipitation depth (inches) from the District Isohyet map. (The value of MSP should be within the range of 10 and 35 inches/year.)
C1 = constant based on rainfall duration and frequency from Table A-3

$$= \frac{MR1}{100} - 10 \times \left(\frac{MR2 - MR1}{250}\right)$$

C2 = constant based on rainfall duration and frequency from Table A-4

$$= \frac{MR2 - MR1}{250}$$

Table A-3 C1 Constants for Storm Rainfall Depths - Simplified

C1	3-hour	6-hour	12-hour	24-hour	96-hour
2-year	0.246	0.286	0.330	0.356	0.316
5-Year	0.374	0.432	0.492	0.556	0.628
10-Year	0.434	0.520	0.588	0.636	0.684
25-Year	0.492	0.584	0.680	0.736	0.904
50-Year	0.592	0.674	0.768	0.840	1.052
100-Year	0.620	0.760	0.888	0.968	1.088

Table A-4 C2 Constants for Storm Rainfall Depths - Simplified

C2	3-hour	6-hour	12-hour	24-hour	96-hour
2-year	0.0304	0.0444	0.0640	0.0884	0.1684
5-Year	0.0436	0.0648	0.0928	0.1304	0.2392
10-Year	0.0516	0.0760	0.1112	0.1584	0.2976
25-Year	0.0608	0.0916	0.1320	0.1884	0.3456
50-Year	0.0688	0.1036	0.1512	0.2160	0.3928
100-Year	0.0760	0.1120	0.1632	0.2352	0.4432

Use the number of decimal places shown for C1 and C2 to produce the same results as the more complicated equation using MR1 and MR2.

Example Storm Depth Calculation

For a watershed with a mean seasonal precipitation of 18 inches (MSP = 18) we can find the 100-year 12-hour storm depth as follows:

MSP	=	**18** inches
Return Period	=	**100**-years
Duration	=	**12**-hours

<u>**HYDRO6**</u>

MR1	=	**252** from Table A-1
MR2	=	**660** from Table A-2

D = (MR1/100)-(10-MSP) · (MR2- MR1)/2500

D = (**252**/100)-(10-**18**) · (**660**- **252**)/2500

<u>**D = 3.83 inches**</u>

OR

<u>**Simplified**</u>

C1	=	**0.888** from Table A-3
C2	=	**0.1632** from Table A-4

D = C1 + MSP · C2

D = **0.888** + **18** · **0.1632**

<u>**D = 3.83 inches**</u>

APPENDIX B Rainfall Distribution Curves

Please note that the time interval for the rainfall distribution curves is not the same for all storm durations. The time interval for each rainfall distribution curve is displayed in the second row of the table. The tabulated numbers are in percentages.

Table B-1 Rainfall Distribution Curves

Duration	3-HR	6-HR	12-HR	24-HR	96-H
Interval / Index	15-MIN	15-MIN	15-MIN	30-MIN	2-HR
1	3.0	2.1	0.9	0.87	-
2	2.0	2.5	0.9	0.87	0.1
3	5.0	3.8	1.0	0.88	0.7
4	2.8	4.5	1.0	0.88	1.6
5	8.8	6.0	1.1	0.92	1.4
6	10.2	3.0	1.1	0.98	3.6
7	5.5	2.3	1.1	1.07	5.6
8	7.0	2.5	1.2	1.13	4.1
9	10.5	4.8	1.2	1.18	2.0
10	11.0	4.3	1.2	1.22	0.6
11	27.7	2.6	1.3	1.23	0.4
12	6.5	2.5	1.5	1.27	-
13		2.2	1.6	1.41	0.1
14		2.5	1.6	1.69	0.2
15		5.0	1.7	1.86	-
16		7.9	1.7	1.94	-
17		19.0	1.9	2.50	-
18		6.3	2.0	3.50	-
19		4.0	2.3	4.90	-
20		3.0	3.0	21.20	1.1
21		2.5	3.2	6.80	0.4
22		2.4	4.1	4.00	4.7
23		2.2	4.9	3.25	3.0
24		2.1	14.6	2.85	3.6
25			6.1	2.52	2.4
26			3.6	2.28	3.6
27			3.1	2.03	5.0
28			2.8	1.77	4.4
29			2.6	1.62	4.4
30			2.1	1.58	4.4
31			2.0	1.53	3.3
32			1.8	1.47	4.7
33			1.7	1.42	13.7
34			1.7	1.38	3.6
35			1.6	1.33	4.6
36			1.6	1.27	4.4
37			1.3	1.22	3.4
38			1.2	1.18	1.5
39			1.2	1.12	0.9
40			1.2	1.08	-
41			1.2	1.03	0.2
42			1.1	0.97	1.2
43			1.1	0.93	1.1
44			1.1	0.87	-
45			1.0	0.83	-
46			1.0	0.77	-
47			0.9	0.73	-
48			0.9	0.67	-
Total %	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

APPENDIX C Depth Area Reduction Factor (DARF)

The following table is the District's adopted Depth Area Reduction Factor (DARF) table. The purpose of the DARF is to account for the size of the watershed. A smaller watershed could experience relatively uniform rainfall over its entire area. A larger watershed is less likely to experience uniform rainfall depth over its entire area. Therefore, the DARF decreases as the watershed areas get larger.

The District's DARF is used only for watersheds larger than 3 square miles. The storm rainfall depth is multiplied by the DARF before the rainfall is distributed over time using the distribution curves.

The depth of rainfall from the District's DFD graphs is a "point rainfall depth"; that is, the rainfall at a specific point on the map. Applying this depth over the entire watershed gives the desired flow rates. However, if the watershed is large, it is unreasonable to assume that the center of the storm can cover the entire watershed. You could not expect the entire county to experience the 10-year 3-hour storm at the same time.

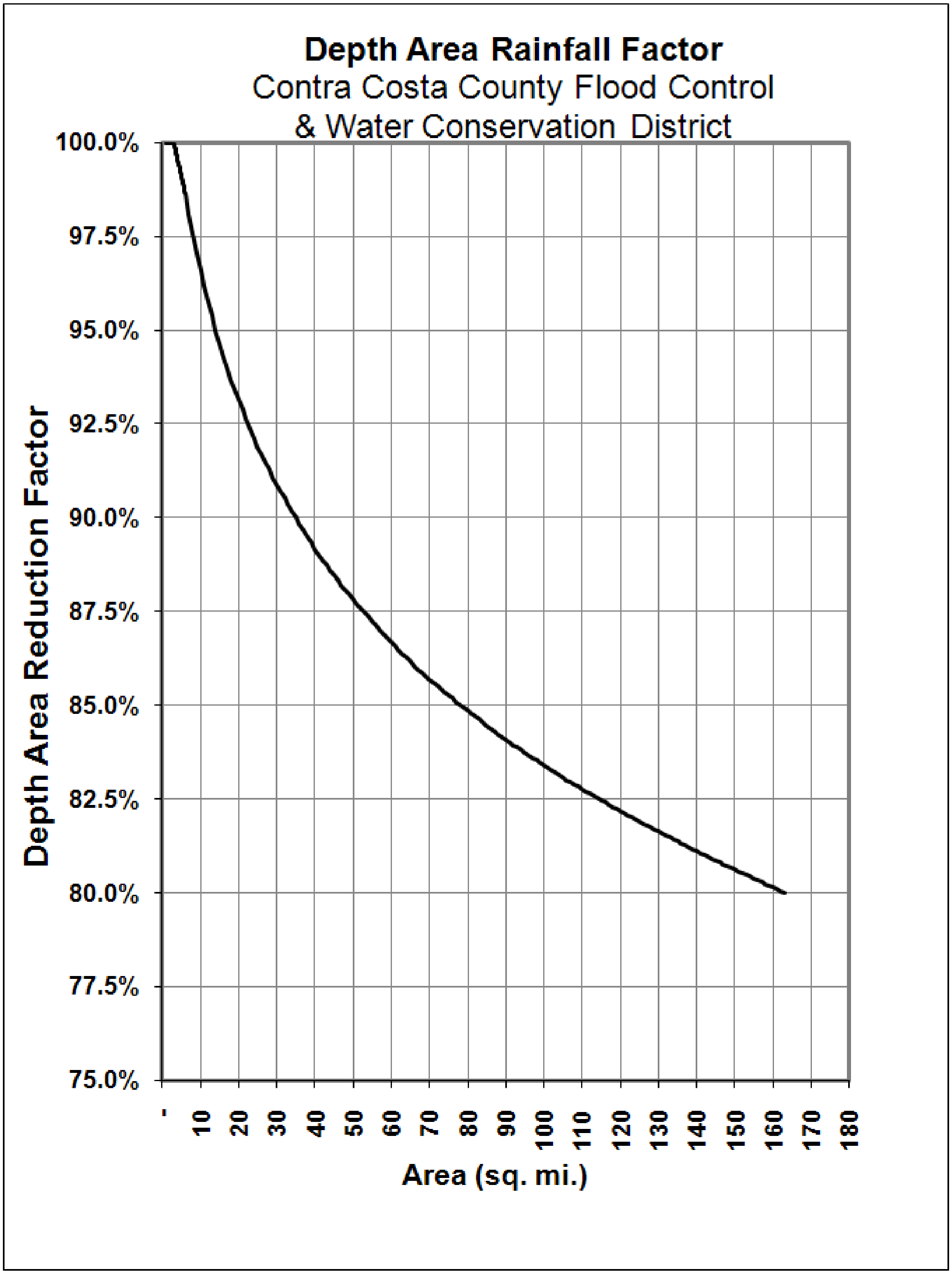
In the event that several large tributaries are being analyzed, a storm might be "centered" over the primary watershed and its DARF would be high, whereas the other watersheds would have a lower DARF because they are farther away from the main tributary. For example, if a storm is "centered" over downtown Walnut Creek, some rain will likely fall in downtown Concord, but you wouldn't expect the storm to be large enough to deliver the same depth of rain downtown Concord. As you move away from the center of a storm the rainfall amount diminishes and therefore the average storm depth over the watershed should be reduced.

Table C-1: Areal Rainfall Reduction Factor Table

Interpolate as needed.

Area Square Miles	DARF %
0.0	100%
3.0	100%
5.3	99%
7.2	98%
9.1	97%
11.4	96%
14.0	95%
16.8	94%
20.5	93%
24.5	92%
29.3	91%
35.0	90%
41.0	89%
48.5	88%
57.0	87%
66.5	86%
78.0	85%
91.0	84%
106.0	83%
123.0	82%
142.0	81%
163.0	80%
184.0	79%
205.0	78%
226.0	77%
247.0	76%
268.0	75%
289.0	74%
310.0	73%
331.0	72%

Figure C-1 Areal Rainfall Reduction Factor Standard



APPENDIX D Lag Time Equation

The Corps used the April 1958 storm rainfall records and flood hydrograph recorded at the USGS San Ramon Creek at San Ramon gage to derive the unit hydrograph for that un-urbanized watershed. An equation for lag time (T_{lag}) and one for the time-rate of change of runoff were also developed for the construction of synthetic unit hydrograph for an un-urbanized watershed. The lag equation used here is very similar to the Snyder Method[10], but was customized by the Corps. This customization introduced the "N" values and related the effect of development on the lag time. The lag time (in hours) is expressed by the following equation:

$$\mathbf{T_{lag} = Lag\ time = 24 \times N \times \left(\frac{L \cdot L_{ca}}{S^{0.5}}\right)^{0.38}}$$

Where: T_{lag} = Elapsed time from the beginning of an assumed continuous series of unit effective rainfalls over and area to the instant at which the rate of the resulting run-off at the area concentration point equals 50 percent of the maximum (ultimate) rate of the resulting run-off at that point. This therefore corresponds to the Time = 100% and volume = 50%

L = length of the main drainage path (miles)

L_{ca} = length along the drainage path from a point opposite[11] the centroid of the watershed to the outlet point (miles)

S = overall slope of the main watercourse (feet/mile),

N = weighted watershed Manning coefficient (dimensionless)

The parameters used in the T_{lag} equation are explained in the HYDRO6 input requirements on the District's website under "Hydrology Requests" at http://www.cccounty.us/index.aspx?nid=893.

[10] Franklin F. Snyder, "Synthetic Unit-Graphs", Transactions, American Geophysical Union, 1938. See publication at http://www.cccounty.us/DocumentView.aspx?DID=3687.

[11] Opposite – This term was used by Franklin F. Snyder in his 1938 report. It has been interpreted to mean a point on the main watercourse or channel determined by the perpendicular projection of the centroid to the main watercourse or channel.

APPENDIX E District HEC-HMS Template

HEC-HMS Template

The District has created an HMS model for the Contra Costa County method as a Template Model (Template). The purpose is to decrease the time involved in creating a model using the District method. The Template was created and made available for the convenience of those using the District's method and the users are directed to the Disclaimer at the front of this document.

Template Contents

The Template contains the following:

1. One basin that has one subbasin.
2. Pre-named Meteorological Models
3. Control Specifications that match the time windows of the time series data.
4. Time series precipitation gages (3-, 6-, 12, 24-, and 96-hour) per the District's standard rainfall distribution curves.
5. The Walnut Creek Mountain S-curve as paired data
6. Pre-named Simulation Runs
7. U.S. Customary Units

Using the Template

The Template is available for download from Districts website in the form of a zip file. You will find it under links on the Districts Hydrograph Standards page at http://www.cccounty.us/index.aspx?NID=2664.

The location of this link may change as we have not settled on the best location on the website for this link and other standards.

When you have the file, do the following:

1. Right click on the link and save the file to your computer or server.
2. Unzip it in a directory of your choice.
3. Start HMS and open the ".hms" file from the project directory.
4. Use the **File/Rename** function to rename the model. This seems to work better than the Save As function in that there the model does not freeze up and the ".run" file and DSS file problems do not crop up. Delete any files in the new directory having the old project name.

OR

5. Use the **File/Save As** function to save the model under a different name. We have had problems with the Save As function and have reported them to HEC. These "bugs" are not difficult to work around. They are:

a. **ERRORS DURING "SAVE AS":** For some reason, District staff has problems with HMS when using the Save As function. We do not know if this is because of our operating system or inherent in the latest HMS version. The following error is presented by HMS after using Save As and then it becomes unresponsive:

   ERROR 10000: Unknown exception or error; restart HEC-HMS to continue working. Contact HEC for assistance.

   WORK AROUND: A remedy to this error is to force HMS to close and restart it. We use the Windows Task Manager, find the HMS.exe image name under the **Process** tab, and click "End Process". Otherwise, the Save As function appears to work in that it does correctly saves the project under the new project name. The only problem remaining during the Save As process is discussed below.

b. **PROBLEM WITH SAVE AS:** The Save As function will create a new directory with the same files as the "parent" project, but using the new project name. However, the newly created project run results go into a DSS file in the new project folder that has the name of the "parent" HMS project. The new project DSS is there, but the results go to the other folder.

   WORK AROUND #1:

   i. Carefully edit the ".run" file in your new directory using Notepad.
   ii. Use the Replace function in Notepad to replace the old DSS filename with the new DSS filename for each run in the file.
   iii. Delete any files in the new directory having the old project name.
   iv. Check that the old DSS file is no longer used by your model by running a simulation and checking the project directory to see if it contains a DSS file with the old project name.

   WORK AROUND #2:

   i. When on the Compute tab and when you click on a simulation run icon, the Simulation tab has several fields. One of the fields is the "DSS File" Field.
   ii. We have found that in HEC-HMS v3.5 when edit the file name in the "DSS File" field and save the HMS model, the ".run" file is modified so that the output goes to the correct location.
   iii. You can find the project DSS path when you click the top folder on the Components tab. You can copy and paste this path to the simulation runs.

6. Rename the basin model and subbasin to appropriate names for your project.
7. Create more subbasins, if needed. You can copy the one in the Template using the copy option on the right click menu. The settings of the Template subbasin will be preserved so you only have to change the data.

8. Calculate the watershed parameters (Area, Infiltration Rate, N-value, L, L_{ca}, Delta H, etc.) for the subbasins and from them calculate the T_{lag}.
9. Enter the watershed parameters and calculated parameters into the appropriate subbasins in the model.
10. Calculate the storm depths for your design storms and add them to the Meteorologic Models for each subbasin and choose the appropriate gage for the subbasin.
11. To use the simulation runs, click on them and change the basin model, Meteorologic Model, and Control Specifications. You can also copy them; rename them to better describe what the runs are for. The Meteorologic Models already assigned to them should be appropriate.

APPENDIX F HEC-HMS vs Hydro6

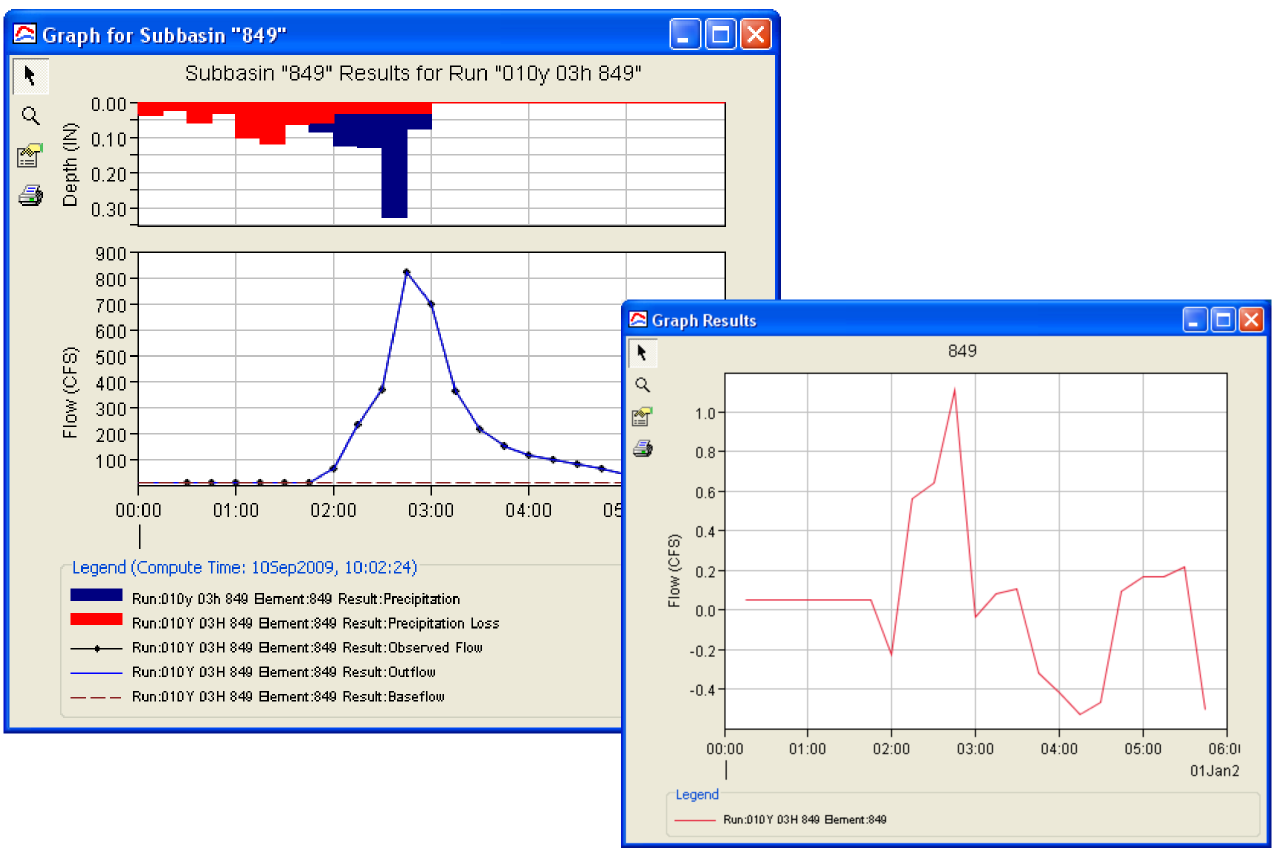
HYDRO6 was developed specifically to produce hydrographs for Contra Costa County. HYDRO6 has proven reliable and effective for many years for flood control purposes. The methods it uses are sound.

With the exception of an added option to route a hydrograph using the Tatum method at the end of a run, HYDRO6 has limited abilities compared to HEC-1 and HMS.

Comparison of HYDRO6 and HEC-HMS Output

An example of how well HMS can match HYDRO6 is shown in **Figure F-1**. This is for a 2.21 square mile (sq. mi) watershed. HMS will calculate the residual, which is the difference between the modeled results and "observed" data. In this case, the observed flow is the HYDRO6 output. The residual plot from HMS is shown in **Figure F-1**. The residual at the peak flow is just over 1 cfs, which is very minimal compared to the peak 800+ cfs.

Figure F-1 Comparison of HYDRO6 and HEC-HMS Output



Observed Issues with HYDRO6

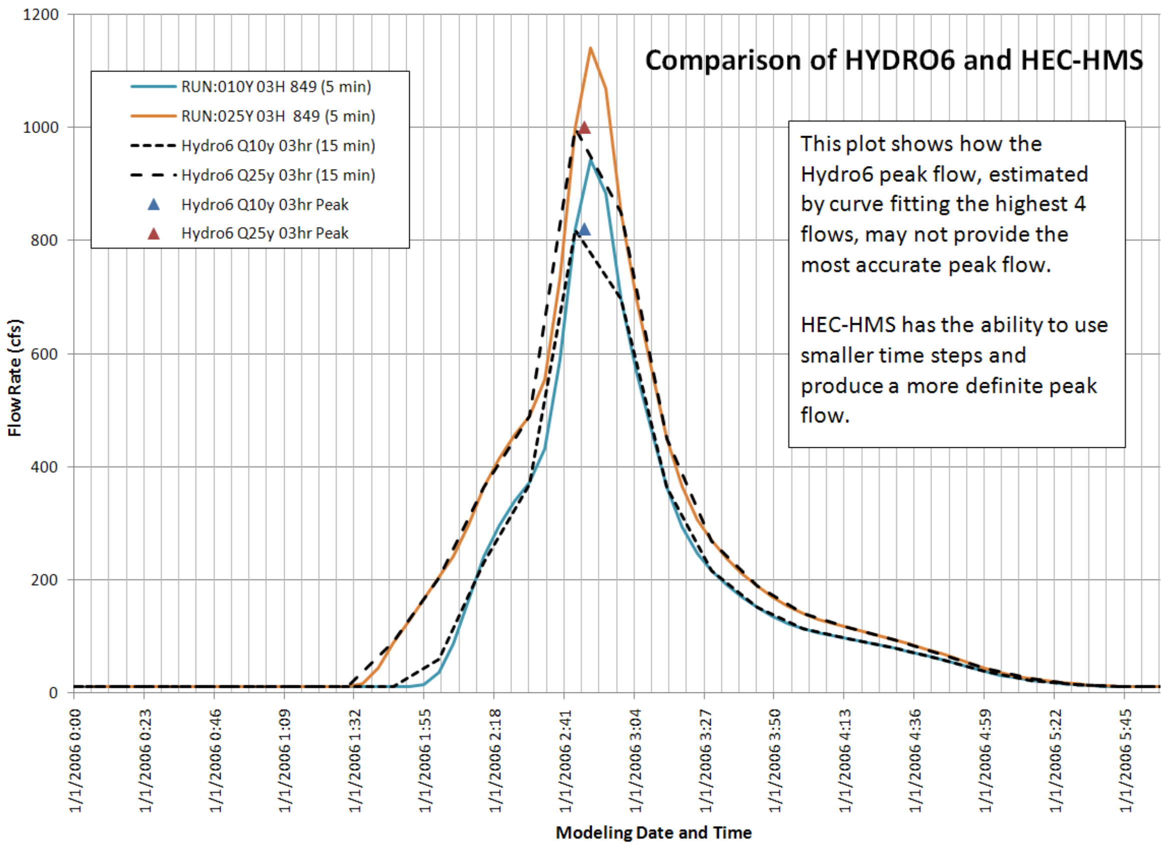
We have observed a few minor issues with the HYDRO6 program:

1. For small design storms of 2-year in frequency when there are high infiltration rates, the peak flow output at the bottom of hydrograph is set equal to the model time step. That is, when the model is run for 15 minute time steps, even though there is no effective runoff due to the low storm depth and high infiltration rate, the peak flow calculated is printed as equal to 15 cfs. If the time step is changed to 5 minutes, the peak flow is printed as equal to 5 cfs.

2. HYDRO 6 calculates the peak flow between modeled data points using the highest 4 flow rates and fitting them to a parabolic curve. On very rare occasions, the HYDRO6 will calculate the peak flow lower than the flows on the hydrograph. When comparing the peak flow value and time with HMS output, it appears that both peak flow value and time are not well estimated using parabolic curve fitting. The **Figure F-2** is an example of this issue.

   In **Figure F-2**, the black dashed lines are the 10-year and 25-year 15 minute hydrographs from HYDRO6. The triangles are the peak flows calculated by HYDRO6 placed in time as HYDRO6 produced them. The solid colored lines are hydrographs from HMS using the same watershed and storm parameters, but running the model with a 5-minute time step. This clearly shows at potential problem with the peak flows estimated by HYDRO6. They are likely lower than they should be.

Figure F-2 Comparison of HYDRO6 and HEC-HMS Peaks



APPENDIX G Stream Routing

In the HYDRO2 program, the routing method used was the Tatum method. This method is not available in HMS. We have reviewed the Straddle Stagger method and have determined that the following replacement coefficients can be used for the 15 minute time step models. We have not verified that this works for other time step based models.

Tatum Method	Straddle Stagger Method	
Steps	Lag	Duration
1	Don't Use SSM	
2	7.5	10
3	15	30
4	22.5	30
5	30	45

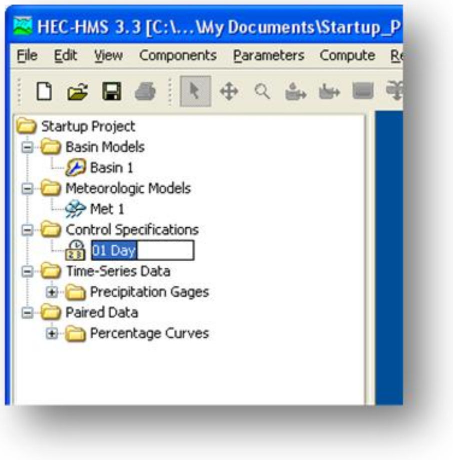
APPENDIX H HMS Tips

The following tips apply to different section in the main text of this document, but were grouped here for simplicity.

Save Often

We have found that HMS v 3.3 is not entirely stable. Some features stop working or the program freezes up and the program needs to be closed and restarted. It may occasionally crash. The Corps is continually modifying and upgrading HMS. We assume that these problems will diminish as newer versions are released. The Corps normally publishes the upgrades as complete software updates, not patches, and there is no public notification list for updates that that we are aware of. You can report a bug in HMS via an email address on their web site at http://www.hec.usace.army.mil/software/hec-hms/bugreport.html.

Renaming

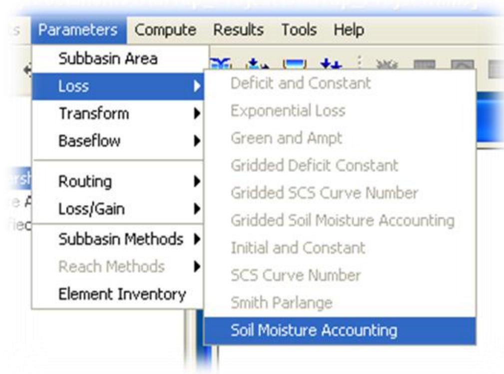


It is usually helpful to be able to rename the components after creating them. This can be done by clicking twice on the name in the folder view. There is a long pause before the programs reacts, but when it does you will see a text "box" appear around the highlighted text where you can edit the name of the component. You can also activate the renaming by right clicking on the component and choosing "rename" from the menu or by pressing F2. HMS will occasionally not allow renaming of components. One solution to this problem is to close the program and try renaming after opening the project again.

Pasting data from Microsoft Excel

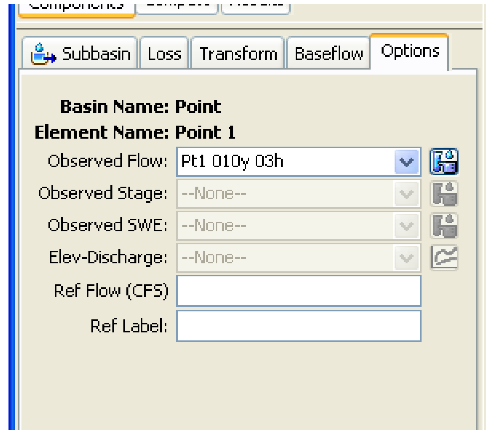
When pasting data from Microsoft Excel to HMS fields, Excel data must be in Excel "General" or "Number" format. If is in any other format, the numbers will appear when pasted, but when you save the project, the numbers will likely disappear. This happens for all cases of copying from Excel to HMS. It helps to test that the pasted values will stay by saving the model before clicking out of the table or menu the data is pasted to.

Editing Parameters in Tables



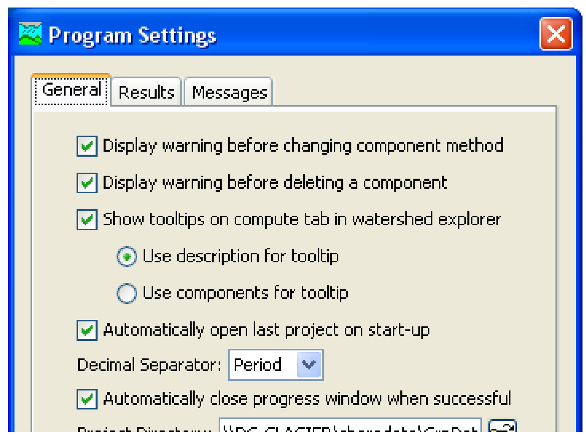
If there are several subbasins in your model, an easy way to edit the parameters to use the **Parameters** menu. This brings up a list of all the several parameters that you can see in table format. Set the "Show Elements" selection box to "All Elements" to see all of them at once.The values can copied from the list or from a spreadsheet and pasted in.

Options Tab – Subbasin



The **Options** tab appears when selecting a subbasin is used to bring observed data into the model for comparison or calibration purposes.

For example, if you have hydrograph you want to compare the HMS results to, you can input it as time series data and then pull it up under the **Observed Flow** option shown in the image to the right. When you plot the model results for this subbasin, the observed flow will plot along with it. The **Results** tab will also provide more information such as "Residual Flow" (the difference between the observed and modeled hydrographs).



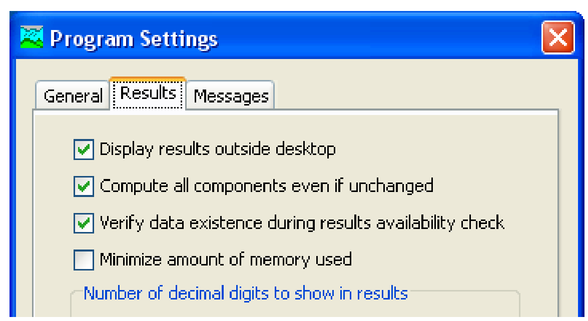
If you have a target peak flow that you are trying to mitigate to, you can type that flow rate into the **Ref Flow** field and it will plot as a horizontal line on your results plot.

Open Last Project

Under the **Tools>Program Settings General** tab, you can tell HMS to open that last project on startup.

Close Simulation Run Progress Window

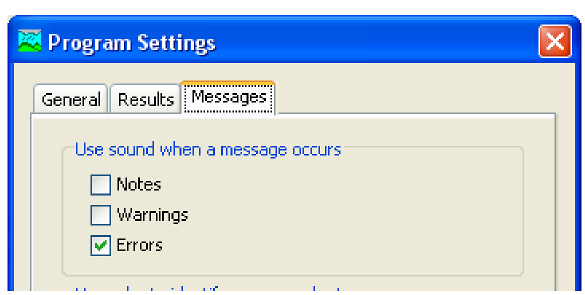
Under the **Tools>Program Settings General** tab, you can set the program settings so that the progress window automatically closes (see image below).



Viewing Results

Under the **Tools>Program Settings** menu, you can set the "Results" settings to have the program "Display results outside desktop". This causes the results windows to pop up outside of the HMS window and so provides more room for reviewing results.

Message Tone Options



Under the **Tools>Program Settings** menu, you can change the "Messages" settings to reduce the tones the program makes when it displays Notes, Warnings and Errors.

Copying Graphics to Reports

In the Windows® operating system, the "Alt-Print Screen" key stroke copies the active window (not the entire screen) to the clipboard for pasting into a report. This is useful when trying to communicate model inputs or results in a report.

HEC User Support

Users of HEC software ask questions and share ideas through a HEC-USERS listserv. For subscription information or if you have any question about the HEC-USERS list, write to the list owners at the following address: HEC-USERS-request@LISTSERV.UOGUELPH.COM

Time Windows

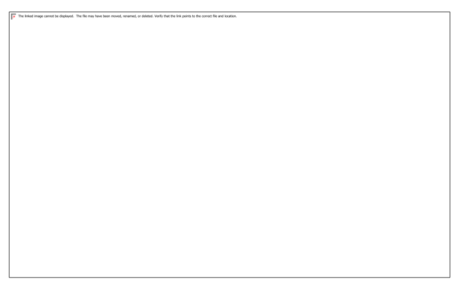
HEC-HMS adds "time windows" when the data is used for a Control Spec. If, for example you run a model with a 3-hour storm for 24-hours to see how long a detention basin takes to drain, a 12-hour time window is created for the 3-hour precipitation gage. You can delete it, but it will come back if you re-run the 12-hour model. Having blank cells in the precipitation data will produce messages or warnings during the simulation run, but will not cause computational errors.

Total Override

The rain gage is used in conjunction with the Meteorologic Model. The Meteorologic Model has an option called "total override". When you turn this on, a rainfall depth is put into the Meteorologic Model and the model uses the rain gage as the pattern for the rainfall. We typically refer to this as a "rainfall distribution curve".

HEC-HMS v3.4 and v3.5 Issues (updated 8/16/11)

District staff has had some issues with HEC-HMS version 3.4 and 3.5 prior to upgrading to Windows 7. These versions both worked for a short time in the previous version of the Windows operation system and then the program crashed. When trying to start it again the program would crash and display the error message to the right.



District staff reported this error to the HEC staff in Davis, CA and there are ongoing discussions to understand why we get this error and possible solutions. HEC staff has suggested that there is a conflict with a printer driver installed on District staff's machine that is causing this.

We tried uninstalling all HEC-HMS versions and all Java versions and then reinstalling them. So far, none of these efforts has solved the problem.

We have not found the cause of the error. Since Windows 7 is becoming more commonly used, we do not intend to try to find a work around to this problem.

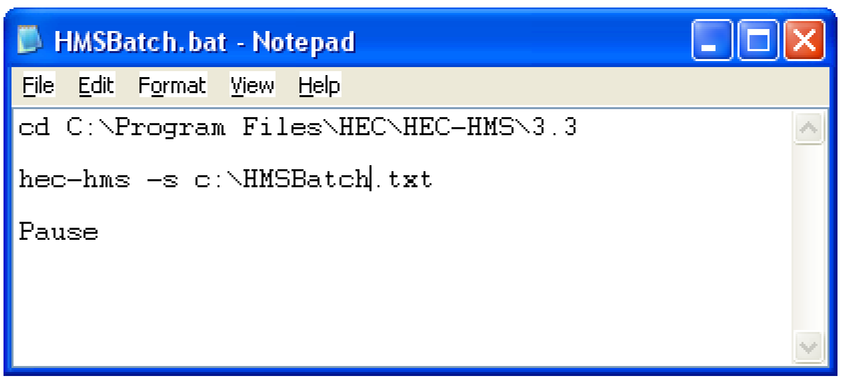
APPENDIX I Running HMS in Batch Mode from the DOS Window

There may be times when a model has several Simulation Runs and the user wants to run them all after a modification of the model. This can be somewhat tedious, though not too bothersome. There is a way to run several Simulation Runs at a time. Those with a little computer suaveness may find this interesting and convenient.

This operation requires two files in the root directory of the C: drive

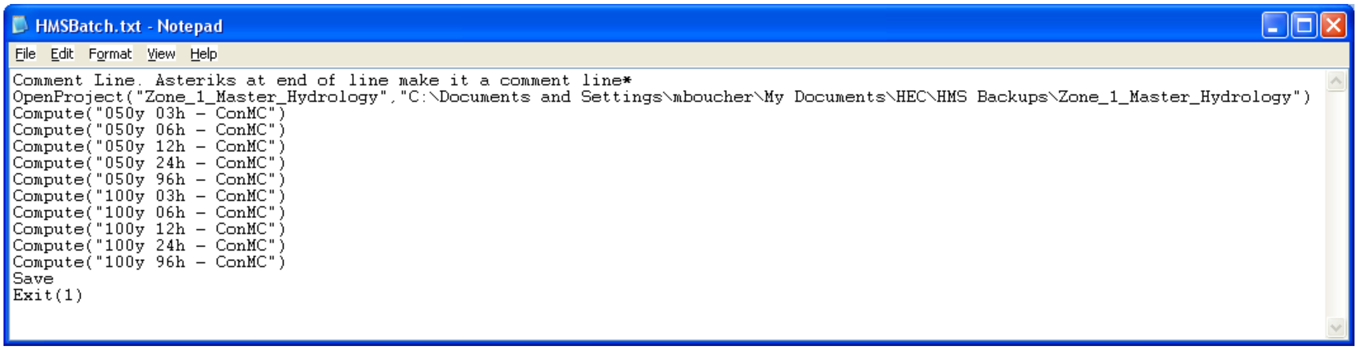
Batch File

Create a file with the extension “bat”. For example, use Notepad to create a new file. Save it under **c:\HMSbatch.bat**. Type the following lines in that file.



The “Pause” command at the end simply causes the MS DOS window to stay open. This allows confirmation that the bat file has run and is finished. Otherwise, the window will simply close and you will not know if the processed succeeded or failed.

Next, create another file using Notepad that has a file name that is that same as that in the second line of the bat file. For example, the file that goes along with the above bat file would be named HMSBatch.txt. It should contain the text as follows:


HMSBatch.txt - Notepad

File Edit Format View Help

```
Comment Line. Asteriks at end of line make it a comment line*
OpenProject("Zone_1_Master_Hydrology","C:\Documents and Settings\mboucher\My Documents\HEC\HMS Backups\Zone_1_Master_Hydrology")
Compute("050y 03h - ConMC")
Compute("050y 06h - ConMC")
Compute("050y 12h - ConMC")
Compute("050y 24h - ConMC")
Compute("050y 96h - ConMC")
Compute("100y 03h - ConMC")
Compute("100y 06h - ConMC")
Compute("100y 12h - ConMC")
Compute("100y 24h - ConMC")
Compute("100y 96h - ConMC")
Save
Exit(1)
```

The first line is optional and can be used as a comment line for the run. The “*” at the end makes it a non-executable comment line. The second line opens the project. Take care to be sure the quotations are consistent. The command is:

OpenProject(“project name”, “Project Directory”)

The compute command is:

Compute(“simulation run name”)

and must be repeated for each simulation run you want to be performed.

The ending comments are “Save” and “Exit(1)” as shown above.

To run the batch file, in Windows Explorer either double click the bat file icon or right click and choose “Open” off the menu.

When the bat file is run, the MS DOS window opens and echoes the first two lines in the bat file. If several long simulations are being run, the user can check to see that the process is actually running by opening the project directory and viewing the details of the file (file size, file data and time, etc.). The size of the “.dss” file, the “.out” file, and other files should change when the Windows Explorer view is refreshed (Choose View>Refresh). This may periodically happen automatically, or the user can press “F5” to manually update the view. The change in size confirms that the model is running.

There is issue with running the model in this batch mode. When run in batch mode, the icons in the “Results” tab in HMS will not be updated to reflect that the simulations ran. However, the DSS file will reflect the results of the runs.